2236

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K/EM-107

STATUS REPORT, CLINTON PRODUCTION DIVISION

(Sanitized Version of KZ-8178--dated June 30, 1947)

Compiled by
S. G. Thornton
Environmental Management Division
OAK RIDGE K-25 SITE
for the Health Studies Agreement

April 1, 1995

Oak Ridge K-25 Site
Oak Ridge, Tennessee 37831-7101
managed by MARTIN MARIETTA ENERGY SYSTEMS, INC.
for the U.S. DEPARTMENT OF ENERGY
under Contract DE-AC05-84OR21400

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OAK RIDGE GASEOUS DIFFUSION PLANT

operated by

UNION CARBIDE NUCLEAR COMPANY

A DIVISION OF UNION CARBIDE AND CARBON CORPORATION

for the Atomic Energy Commission

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APR 30 1951
By B Doughty

PLANT RECORDS
RECEIPT NO.
I18578

APR 30 1953

INVENTORIED
OCT 31 1951
By B Doughty

APR 30 1952

OCT 31 1952

INVENTORIED
OCT 30 1953
By ERP

INVENTORIED
MAY 1954
By ERP

INVENTORIED
MAY 2 1955
By JW

11-2-55
By LB

TOP SECRET INVENTORY	
5-11-66	HF
11-1-66	HF
5-2-67	HF
11-6-67	LR

STATUS REPORT

CLINTON PRODUCTION DIVISION

June 30, 1947

KZ 8178 7A

TOP SECRET INVENTORY	
Date	By
NOV 2 1959	WOH
APR 29 1960	WOH
NOV 1 1960	HF
APR 24 1961	LB
OCT 25 1961	LB
4-25-62	HF

TOP SECRET INVENTORY	
5-1-56	LB
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4-30-57	LB
10-31-57	HF
5-1-58	LB
NOV 4 1958	WOH
APR 30 1959	WOH

TOP SECRET INVENTORY	
Date	By
[illegible] 1962	WOH
MAY 1 - 1963	WOH
NOV - 1 1963	WOH
APR 28 1964	WOH
11-2-64	HF
5-4-65	HF
11-3-65	HF

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STATUS REPORT - CLINTON PRODUCTION DIVISION

PART 1 - K-25 GAS DIFFUSION PROJECT

I. BRIEF HISTORY

A. Background

In December, 1938, O. Hahn and F. Strassmann discovered the fission of uranium. By March, 1940, J. R. Dunning and others had proved that fission was due to the U-235 isotope, which is present to the extent of only 0.71 percent in natural uranium. During 1940 and 1941 the importance of U-235 for a possible chain reaction was realized, and various methods were considered for separating the U-235 from the other uranium isotopes.

Chemical, distillation, centrifuge, thermal diffusion, electromagnetic, and gas diffusion methods were studied. The chemical and vaporizing properties of the isotopes were so similar that the first two methods were discarded. The centrifuge method would require high speed machines not yet developed. The thermal diffusion method was developed and a plant (S-50) built to obtain a slight separation. The electromagnetic method resulted in a plant (Y-12) which was operated in series with the gas diffusion plant (K-25) to produce concentrated U-235, between March 31, 1945 and June 12, 1947. At present all production scale isotopic enrichment of uranium is carried on at K-25.

The following are the principal contractors concerned with the gaseous diffusion projects

Columbia University - Research and Development - W-7405-eng-50
Kellex Corporation - Design and Engineering - W-7405-eng-25
J. A. Jones Construction Co., Inc. - Construction - W-7421-eng-11
Carbide and Carbon Chemicals Corporation - Plant Operation - W-7405-eng-26

B. Purpose

The K-25 plant was built to concentrate the U-235 isotope using uranium hexafluoride as a process gas. Separation was effected by passing the gas through 2892 diffusion stages connected to form a "cascade". The feed entered the plant near the "bottom" of the cascade, the waste was withdrawn at the bottom, and the product was taken off at the top.

In order to increase production capacity, an auxiliary 540-stage cascade (known as K-27) was subsequently constructed and connected to form an integral part of the gas diffusion plant. It is currently operated continuously in conjunction with the main K-25 cascade in such a way as to effect considerable preliminary enrichment of the feed material.

Of the gas pumped into any one stage, half is allowed to diffuse through the small holes of the porous walls of the barrier tubes within the diffusion stage. This half of the gas becomes partially enriched in U-235 because of the tendency of the lighter U-235 hexafluoride molecules to pass through the small holes of the barrier more readily than the slightly heavier U-238 molecules. This gas is pumped to the next higher stage for further enrichment. The half of the gas passing undiffused through the barrier tubes, partially depleted in U-235, is sent back to the next stage below, where it makes up part of the feed for that stage. The degree of separation in any one stage is very slight; thousands of stages are necessary in order to obtain the degree of separation required.

Originally it was intended that the gas diffusion plant should produce one kilogram per day of U-235 at a concentration of 90 percent.

Early in 1945 the addition of K-27 was authorized, for the purpose of increasing the output of the gas diffusion plant at any given purity of product. Operation of the plant at a product concentration of 93.5 percent, since December 3, 1946, has shown that the addition of another section to the top of the plant is not necessary.

C. Research and Development

In 1941 O.S.R.D. contracts were arranged to expand the work of H. C. Urey and J. R. Dunning. In May, 1943, these contracts were supplanted by a War Department contract, under which the work was to be directed by H. C. Urey. In February, 1945, the research on gas diffusion was transferred to Carbide and Carbon Chemicals Corporation, and continued at Columbia University until the middle of 1946. In addition to research at Columbia University, work was done by the Kellex Corporation, Bell Telephone Laboratories, Linde Air Products Company, Princeton University, and other companies and universities. Research, development, and production of certain special materials were

Other research and development projects include mathematics of the gas diffusion process, uranium chemistry, mechanical equipment, instruments for control and analysis, and pilot plants for the study of the gas diffusion method. During the latter part of 1944 and early in 1945, one building of the main plant was used for development and testing of plant equipment.

Carbide and Carbon Chemicals Corporation has continued research at the plant site pertaining to barrier, mechanical, and process development. A twenty-stage gas diffusion plant is in current operation.

D. Design and Engineering

The design and engineering of the plant was initiated by the M. W. Kellogg Company under an O.S.R.D. contract in January, 1942, and was continued from December 1942, under a War Department contract with the Kellex Corporation and M. W. Kellogg Company.

Top key personnel of the Kellex Corporation were transferred from the M. W. Kellogg Company, and specialists were borrowed from other companies to head the various departments.

K-L-3

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In July, 1942, work was started on a test floor at the Jersey City Plant of M. W. Kellogg to prove operability of gas blowers and other equipment prior to installation in the plant at Oak Ridge, Tennessee. This work continued through December, 1944.

The Kellex Corporation, together with the Army and the operating contractor, made the final selection of a process area site at Clinton Engineer Works in June, 1943.

From 1942 through 1944 the designs of plant equipment were perfected and contracts with other manufacturing companies were awarded for producing the many items required. In most cases development of the equipment was carried out jointly by Kellex and the cooperating manufacturer. A partial list of manufacturers follows:

Manufacturer	Development
M. W. Kellogg Company	Barrier and design of diffusion stage
Chrysler Corporation	Diffusion stages
Lukens Steel Company	Nickel-clad steel
Allis-Chalmers Manufacturing Co.	Stage pumps and electrical generators
Whitehead Metal Products Company	Flat Plate diffusion stages
Valley Iron Works	Reciprocating pumps
Midwest Piping and Supply Company	Piping
Bart Laboratories	Nickel plating of piping
Whitlock Manufacturing Company	Coolant coolers
A. O. Smith Corporation	Coolers
General Electric Corporation	Instruments, meters, generators, etc.
Westinghouse Electric & Mfg. Co.	Pumps and motors
Taylor Instrument Companies	Instruments
Crane Company	Valves
Fisher Governor Company	Control Valves
Combustion Engineering Company	Boilers for powerhouse
Okonite Callendar Cable Company	Electric cable
Hooker Electrochemical Company	Coolant and fluorine, special lubricant
Du Pont Company	Coolant and special lubricant
Harshaw Chemical Company	Uranium hexafluoride

E. Construction

Construction (of the power plant) was begun in May, 1943, with the J. A. Jones Construction Company as the principal contractor. Other construction contractors were Ford, Bacon and Davis, Inc., Wm. A. Pope Co., A. S. Schulman Electric Co., Combustion Engineering Co., Tennessee Valley Authority, Midwest Piping and Supply Co., Pee Piping and Heating Co., Riley Benton Co., and Comstock and Bryant Electric Companies.

The power plant and conditioning building were partially completed by March, 1944. The first building of the diffusion cascade was turned over to the operating contractor on December 29, 1944 and the last building in K-25 was completed in September, 1945. The last K-27 process buildings were turned over in February, 1946.

Individual buildings were transferred to Carbide and Carbon Chemicals Corporation for vacuum testing and operation immediately upon completion. Final completion dates were not delayed in spite of late deliveries of equipment, and design changes which sometimes made necessary the removal and reinstallation of thousands of items of equipment. Personnel was always a problem; a peak load of approximately 25,000 was required in May, 1945.

F. Operation

A War Department contract with the Carbide and Carbon Chemicals Corporation was executed effective January 18, 1943, for operation in the gas diffusion plant.

Carbide and Carbon Chemicals Corporation assisted in the design of the plant and operated the 54-stage pilot plant, Building 303-2, prior to the time the other cascade buildings were ready for operation. Carbide also took over the responsibilities of vacuum testing the process equipment after installation by the construction contractor.

Operation of the first building of the cascade was begun in early February, 1945, and all buildings of the main cascade were in operation on August 15, 1945. The buildings of K-27 were placed in operation between December 18, 1945 and February 7, 1946. As soon as the buildings were constructed they were turned over to Carbide for vacuum testing and operation. During the period of February - August, 1945, the fifty-one buildings of K-25 were put into operation at the rate of two buildings per week. Simultaneous adjacent activities of both construction and operating groups hampered each somewhat, but earlier operation of the entire plant was achieved in this way.

Ford, Bacon and Davis constructed the conditioning building, and operated it from June, 1944, until May, 1945. Carbide took over operations on May 1, 1945.

The Hooker Electrochemical Company designed and supervised construction of the fluorine buildings. Hooker also operated the fluorine plant from July, 1944, until Carbide took over operations on February 1, 1945.

II. PRINCIPAL OPERATING CONTRACT

The gas diffusion plant at Oak Ridge, Tennessee is operated by the Carbide and Carbon Chemicals Corporation, New York, N. Y. Carbide initiated work under the provisions of a letter contract dated January 18, 1943, and the formal contract was entered into on November 23, 1943, effective as of the letter contract date.

A. Scope of Contract

Contract W-7405-eng-26 originally provided for the following work under the titles listed:

Title I required the contractor to supply a group of its trained technical personnel to study the available knowledge and information concerning the K-25 plant with regard to its design, engineering, construction and operation.

Title II contained provisions permitting the contractor to conduct research and experimental work as might be deemed advisable in connection with the design, engineering, construction, and operation of the plant.

Title III provided that the contractor supply consultant services to the Government and collateral contractors with regard to technical problems involved in the design, engineering, construction, and operation of the plant. This title further provided that the contractor would recommend a competent organization to assemble, condition, and otherwise prepare the process equipment for initial installation in the plant. Carbide recommended Ford, Bacon and Davis, Inc. for that work.

Title IV provided for the procurement and training of the personnel necessary for the operation of the plant.

Title V provided for the operation of the K-25 plant including its auxiliaries, such as the powerhouse, for the separation of the U-235 content of uranium hexafluoride.

The contract provided for reimbursement of the contractor for all direct costs incurred for labor, supplies, materials, utilities, and services not otherwise provided by the Government, and for an overhead allowance equal to 100% of the direct labor, in connection with Titles I, II, and III, and 100% of the direct labor in connection with Title IV, except where such work was performed in the Government facilities at Oak Ridge, Tennessee. These provisions were generally designed

to compensate the contractor for his overhead expense incurred prior to operation of the plant. The contract provided for the reimbursement of all costs in connection with the operating of the plant, and in addition, a fixed fee of $75,000 after full operation of the plant should be attained. Prior to full operation, pro-rated portions of this fee were to be paid as the various units of the plant were placed in operation.

B. Principal Supplements to Original Contract

On December 31, 1943, the contract was supplemented to provide for the contractor to furnish the necessary guard and fire department services during the construction and subsequent operation of the K-25 plant. The contractor is reimbursed for his cost in connection with this work.

On January 1, 1944, the contract was supplemented to provide for the contractor to take over the coordination, supervision and, when necessary, actual production of barrier for the K-25 plant. This work was incorporated in the contract under the provisions of Title III.

A supplemental agreement was entered into on January 5, 1945, which provided for the contractor to take over, effective February 1, 1945, the work previously performed by Columbia University under Contract W-7405-eng-50, at the S.A.M. Laboratory. The supplement provided for the reimbursement of cost and an overhead allowance equal to 15% of the contractor's labor charges in connection with the work. This work has now been completed and the project is essentially closed out. All research and development deemed necessary or of future value to the operation of the plant has been transferred to the K-25 site.

A supplemental agreement, entered into on July 1, 1945, provided for the contractor to carry on its payrolls a group known as the Nash Patent Group to work under the supervision of a representative of the Patent Adviser for the Manhattan District in the processing of patents originated under project S.A.M.

A supplemental agreement entered into on December 1, 1945, provided for:

a. The operation of the K-27 plant in connection with the K-25 plant with an increase in the fixed fee from $75,000 to $96,000 per month for the combined operation.

b. This supplement also provided that effective July 1, 1944, Carbide would furnish steam, electricity, water and other services, and trained personnel for the S-50 plant.

c. After the S-50 plant was shut down and placed in standby condition, Carbide would provide maintenance, guard, and fire protection services as requested by the Contracting Officer. The contract provides for a fixed fee of $1.00 for the work in b and c.

d. This supplement confirmed the previous instructions of the Contracting Officer that the contractor would perform, beginning July 1, 1944, the leak testing of process equipment in connection with the construction of the plant. The contractor was paid a fixed fee of $24,000 for this work.

e. This supplement further provided that effective January 1, 1945, the contractor would gradually take over from Ford, Bacon and Davis, Inc. the operation of the Conditioning Building, and carry on therein the conditioning of the process equipment for the K-27 plant. A fixed fee in the amount of $35,000 was paid to the contractor for this work.

On January 1, 1945, the term of the contract was changed from "six months after the termination of hostilities with the Axis Powers" to June 30, 1946. On December 1, 1945, this term was further changed to June 30, 1947.

On March 15, 1946, the contract was supplemented to provide for the furnishing of certain personnel to Operations Crossroads.

On July 16, 1946, the contract was modified to provide for the contractor to furnish guard services, fire protection, and other utility services to the area immediately surrounding the K-25, K-27 plant. This change made possible the consolidation of previously duplicated services and effected considerable overall savings.

On June 21, 1946, provision for an "Oak Ridge Patent Group" similar to the "Nash Patent Group" was added to the contract.

On March 29, 1947, the contract was expanded to provide for operation and maintenance of the Y-12 electromagnetic plant, (See Part 2). At this time, also, the term of the contract was extended to June 30, 1951.

III. STATUS OF PROJECT AS OF JUNE 30, 1947

A. Operations

1. Initial Operations - During the latter part of 1944 Carbide and Carbon Chemicals Corporation operated a 54-stage pilot plant at the plant site in Building 303-2 to train operating personnel, and to test stage pumps and instruments. The diffusion stages had no barrier tubes but used steel tubes which were drilled to the porosity of barrier tubes. On January 20, 1945, Carbide began operating the first cell of the diffusion cascade, and on February 10, 1945, the first building was put into operation. Cascade operation was initiated on March 12, 1945, when four buildings were connected together. All buildings of the main K-25 cascade were on stream on August 15, 1945. All buildings in K-27 were operating on February 7, 1946.

2. Production Operations

a. Feed - Facilities were installed in K-25 and also in K-27 for purifying the uranium hexafluoride feed by distillation, if necessary, in order to remove contaminants. However, the feed as received from Harshaw Chemical Company has required no purification, and is fed directly into the cascade through filter screens.

During the period June 1 - September 30, 1945, S-50 product (0.86 isotopic percent U-235) was fed to K-25 Also, during the months of August and September, material from Y-12 in the form of uranium oxide was returned to K-25 for conversion to the hexafluoride to be fed into the plant.

b. Product - Production started in the latter part of March, 1945 with a product averaging 1.1 isotopic percent U-235. As the construction of more buildings was completed, additional diffusion stages were added to the cascade to enable greater production and/or higher purity. The table on Page K-III-3 summarizes the production from the start of operations to June 30, 1947.

of U-234 content of the stream, difficulty was experienced in raising the U-235 concentration above 94%. Consequently, in order to lower the U-234 concentration, product was withdrawn at 94% beginning December 3, 1946. The concentration then gradually dropped to 93.9%, the current product level. Because

c. Waste - The wastes from K-25 (prior to February 7, 1946) and from K-27 (subsequent to February 7, 1946) have been stored in one-ton chlorine cylinders. The K-25 waste, averaging U-235, has been used as an auxiliary feed. The K-27 waste, U-235, is being stored for future consideration.

3. Efficiency of Operations - The following table shows the average monthly cell stream efficiency for representative months of operation. The cell stream efficiency represents the total cell hours on-stream expressed as a percentage of cell hours of operation if all cells were in the cascade during the entire month.

Month	Stream Efficiency
April, 1945	97.3

Period	Approximate Stages Operable Beginning	Approximate Stages Operable End	Product Quality Wt. % of U-235	Product Quantity* Kilograms U-235/Day
3/30/45 - 5/26/45	300	900		
6/11/45 - 6/30/45	1260	1500		
7/2/45 - 7/19/45	1500	2000		
8/4/45 - 10/24/45	2250	2892**		
10/25/45 - 11/8/45	2892	2892		
11/9/45 - 12/7/45	2892	3432***		
12/8/45 - 2/7/46	2892	3432		
2/8/46 - 4/15/46	3432	3432		
4/16/46 - 7/10/46	3432	3432		
7/20/46 - 11/4/46	3432	3432		
12/3/46 - 6/30/47	3432	3432		

* Does not include inventory changes within the plant.

** K-25 was in 100% operation on August 15, 1945.

*** K-25, K-27 in 100% operation on February 8, 1946.

See also curves on pages K-III-14 through K-III-22.

Month	Stream Efficiency
June, 1945	92.5
September, 1945	95.6
November, 1945	97.4
January, 1946	88.8
April, 1946	98.5
July, 1946	99.6
September, 1946	98.4
October, 1946	99.5
December, 1946	99.7
January, 1947	99.7
March, 1947	99.3
June, 1947	99.8

The efficiency for June, 1945 is low because new sections of the plant were placed into operation during the month, with unusually high percentage of failures of the new equipment.

In September, 1945, the first full month of operation of the entire K-25 cascade, the efficiency was low, mainly because of seal and motor failures in the 306 section, placed in operation during the preceding month. By November, however, the efficiency improved greatly.

In January, 1946, the efficiency was low because of start-up activities in K-27. Also, there was a major power failure during the month which caused some loss of time.

By April, 1946, the efficiency had increased to 98.5%, and July, 1946, showed even a greater improvement to 99.6% for the month. Operation for the first six months of 1947 was at an average efficiency of 99.6%.

In the design of the plant, the average cell-stream efficiency was assumed to be 85%. The particular attention paid to the design, engineering, installation, operation, and

maintenance of plant equipment has been responsible for the increased efficiency, and for a corresponding increase of about 15% in the productivity of the plant.

4. Material Balance and Consumption - The following table shows the material balance on uranium and uranium 235 from the start of operations through June 30, 1947:

	Kg. Uranium	Kg. Uranium 235
Total to account for	1,317,010.05	9518.57
Total accounted for	1,311,577.64	9315.22
Total unaccounted for	5,432.41	203.35

The "total unaccounted for" amount of uranium, 5,432.41 kg., includes the "consumption" of process material, which is defined as the continuous depositing of uranium on all surfaces in the process area exposed to process gas. The total consumption of uranium has been estimated at 7,272 kg., and the total consumption of uranium 235 has been estimated as 167 kg. However, these figures involve an uncertainty factor of 40%. A study is now being made which should result in a more accurate determination of plant consumption.

5. Diversion Control - Operation of the gas diffusion plant at a considerably increased top production concentration beginning in December, 1946, necessitated major changes in plant security controls to reduce still further the possibility of fissionable material loss or theft. The present material diversion control plan operates in four areas of varying degrees of restriction as follows:

a. Protection of the entire plant is afforded by means of a steel fence enclosure with guarded gates. The plant guard force patrols the outer boundries and all internal areas of the plant, including those named below.

b. An inner steel fence surrounds the process area proper.

c. That part of the process area where process material is handled at concentrations above 1% U-235 is isolated by means of third steel fence. An identification system requires special clearance for all visitors, and a check on the necessity of entry.

d. The area described in "c" above has an inner

enclosure which isolates the process piping and product withdrawal room. A visitor to this area must be identified by a member of the supervisory force, is escorted at all times, and is subjected to a physical search of his person at the time of departure.

B. Personnel and Organization of Contractor

A total of 5,379 employees were on the K-25 payroll of the operating contractor as of June 30, 1947. Approximately 16% were females and 84% males. 1660 or 29.8% of these were veterans. For the past year, the hiring of veterans has equalled that of non-veterans. 18.6% of the employees are college-trained.

There are approximately 3,477 hourly employees earning an average of $1.40 per hour or $56.00 per week; 1,099 non-exempt making an average of $49.20 per week; and 1,003 exempt averaging $380.00 per month. The total payroll exceeded $1½ million for the month of June, 1947.

A breakdown of personnel showing the number of employees assigned to each division as of June 30, 1947 is as follows:

Industrial Relations	398	Process	1229
Plant Protection	486	Mfg. Office	611
Eqpt. Test and Inspection	135	Superintendents	84
Power House	402	Laboratory	364
Maintenance	1884	WOX	15
Engineering Development	95		

Labor turnover averaged 1.78% for the period ending June 30, 1947.

Employees housed on the reservation total 4,011, with 818 in permanent type housing units; 83 in victory cottages; 1,798 in prefabricated units; 617 in dormitories, and the remaining 695 in apartments, trailers, hutments, barracks, and farm houses. Employees living outside the reservation total 1,368, most of whom live in Knoxville, Clinton, Harriman, Rockwood or other towns within a radius of about 60 miles of the project.

The Carbide and Carbon Chemicals Corporation's K-25 administrative organization chart is shown on Page K-III-7.

C. Status of Supplies

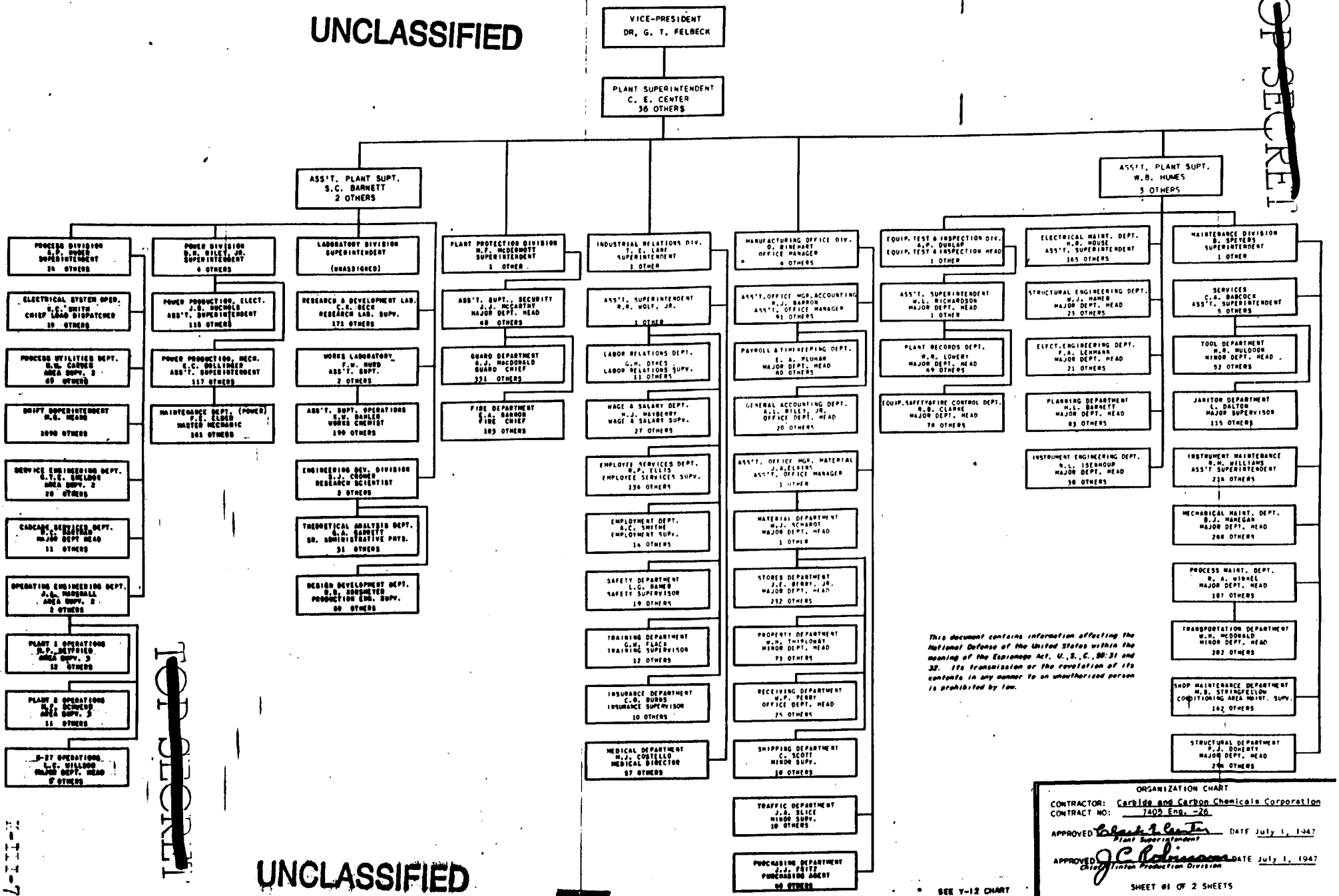
1. General

RESTRICTED

UNCLASSIFIED

TOP SECRET

BAL/ 1,000
DOO 9,870
TOTAL 9,870



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* SEE Y-12 CHART

ORGANIZATION CHART

CONTRACTOR: Carbide and Carbon Chemicals Corporation
CONTRACT NO: 7405 Eng. -26

APPROVED Edward J. Center, Plant Superintendent DATE July 1, 1947

APPROVED J. C. Robinson, Chief, Clinton Production Division DATE July 1, 1947

SHEET #1 OF 2 SHEETS

TOP SECRET

UNCLASSIFIED

a. General - At the present time no great difficulty is encountered because of scarcity of supplies. Most of the supplies can be procured through normal channels, on the open market, and on Treasury Procurement orders. Little difficulty has been apparent in the past three months in obtaining supplies; a priority is seldom required in the procurement of ordinary standard stock items, although priorities are required for certain critical materials.

b. Stockpile - Approximately 60,000 items are carried in stock and in the supply stores, irrespective of mechanical spare parts discussed below. There is approximately 1,234,119 sq. ft. of storage space, of which 759,000 is outside storage, and there are about 111 different warehouse locations. In the majority of the cases a six months' supply is carried in stock.

c. Turnover - Of the above items, approximately 7% of the supply stores are moved in a six months period.

d. Coal - There was an estimate of 150,875 tons of coal on hand as of June 30, 1947, or approximately 93 days' supply. Considerable difficulty has been experienced in the past in procuring coal, and it has been necessary to develop new sources in order to supply the Project. However, this situation has eased considerably. One of the three boilers at the power house was converted so that either oil or coal may be used as fuel, in the event that deliveries of coal are curtailed for reasons beyond the control of the Project.

e. Salvage - Every effort has been made to reduce the number of items for salvage through an extensive maintenance program. Only items that are questionable, damaged, or of obsolete nature are acceptable for a scrap determination. In addition, all machinings and turnings from the machine shops at the site are delivered to the salvage yard and sold as scrap.

f. Excess - Numerous construction and operating supplies continue to be obtained from excess lists circulated throughout the United States Atomic Energy Commission by the various contractors. In turn, Carbide and Carbon Chemicals Corporation has been able to furnish a large amount of construction and operating supplies to the other contractors. This excess was arrived at by the using departments calculating their requirements on a six months basis; items were then placed on excess lists to be circulated throughout the Commission, after which they were turned over to the War Assets Administration.

This procedure has worked to a distinct advantage for all contractors. Approximately $1,400,000.00 worth of excess material has been disposed of, and about $475,000.00 is awaiting disposal.

g. Transportation - Approximately 342 automotive vehicles are in use throughout the K-25 area and used in various operations in movement of material, equipment, and personnel. These vehicles traveled approximately 260,180 miles during the month of June. The number of vehicles has been greatly reduced through the installation of a shuttle-bus system for intraplant transportation. This has decreased the individual usage of cars.

2. Mechanical

a. General - The greater portion of all process equipment is of special design. Established manufacturers entered into direct prime contracts with the War Department to produce the necessary special equipment, and did much to assist in working out many of the research and design difficulties.

b. Stockpile - Approximately 21,000 different items are carried in stock for maintenance of all the specially designed equipment. This represents approximately one to two years' supply with the exception of diffusion stages of which there is an estimated six years' supply.

c. Turnover - Of the 21,000 items stocked for maintenance, there is an approximate five percent turnover during each six months' period of operation. This percentage of turnover will increase gradually over a period of time, building up to approximately thirty percent turnover during each six months' period of operation.

An analysis was recently made of material and storage required for 60 days self-sustained operations in the event of an emergency. With the exception of nitrogen and dry ice, it was found that present stocks and emergency supply sources would be adequate. Further studies are being made to determine the practicability of increasing present storage capacity and to improve emergency sources.

e. Diffusion Stages - There are 3432 diffusion stages installed in the plant. There are 708 spare diffusers (or converters) which could be used as replacements. However, the majority of these are tubed with inferior quality barrier. Replacement of converters in the cascade because of failure has been extremely low. Most of the diffusers removed from the cascade to date have been removed for the purpose of replacement with diffusers containing improved types of barrier. The life of the diffuser unit depends upon the rate at which the minute holes in the barrier tubes become plugged. Prior to July 1, 1947 only 186 diffusion stages had become plugged sufficiently to require the unplugging treatment, and, of this total, 90 were treated in place; 96 were removed for reconditioning on converter furnace stands.

f. Stage Pumps and Motors - 6,888 centrifugal stage pumps, 132 reciprocating pumps, 665 coolant pumps, and an equivalent number of motors to power these pumps are in operation. There are 388 spare stage pumps and 316 spare stage pump motors available as replacements. Failures of stage pumps averaged 10 per month during the first six months of operation in 1947. Failure of stage pump motors decreased from an average rate of 16 per month in 1946 to the rate of 13 per month in 1947.

g. Seals - Approximately 7,000 seals are in use, and there are 2,855 spare seals available. Failure of process seals has decreased from an average rate of 53 failures per month in 1946 to 22 failures per month in 1947.

h. Valves - A total of 251,000 valves are in service, including 114,344 of special design. 1348 of these are operated by electric motors. The original special rubber seats on special valves are being replaced with improved fluorocarbon plastic seats. About 30% of the building and cell process valves have been changed in this way. Plastic seats have been installed in all building by-pass valves.

i. Instruments - 132,157 instruments, 1,085 instrument panel boards, and 63 line recorder units are in service; the greater portion of the instrumentation is of

special design and calibration. Operating experience indicates that the percentage of failure in instrumentation was much lower than had been anticipated.

j. Excess - There has been very little special equipment declared excess with exception of special testing equipment which was procured for use in testing process equipment during various stages of manufacture and installation in the plant. Approximately 60% of the original leak detectors and vacuum pumping units have been declared excess to the needs of the gas diffusion plant.

3. Special Chemicals

a. General - Because of the highly reactive nature of the process gas, special chemicals inert to uranium hexafluoride were developed. All special chemicals were procured through the Madison Square Area of the Manhattan District which negotiated production contracts with various chemical manufacturers.

b. Fluorine (C-216) - The production of fluorine is carried out at the K-25 site in a plant, the maximum capacity of which is 350 pounds per day. The plant was sized to meet conditioning demands during construction and prior to operation. The present usage of fluorine is approximately 600 pounds per month. The plant is operated whenever there is need; consequently, there is only a small storage of fluorine at K-25.

c. Fluorinated Lubricating Oils (KFL, C-214) - There is an inventory of 8,150 pounds of Fluorolube oil now at the site which will last until April, 1954. This corresponds to a usage of 100 pounds per month.

d. Coolant (C-816) - There is a storage inventory of 1,015,157 pounds of Fluorocarbon coolant at the site which will last approximately 10.5 years. This large production of coolant was based on estimated design loss figures; however, improvements in plant equipment and rigid operating control have reduced losses so that an originally estimated two years supply of coolant will now last over ten years. Present usage is 8,000 pounds per month. Because of the large inventory, Madison Square Area has disposed of Government owned facilities for producing this material.

e. Uranium Hexafluoride (C-616) - There is an inventory of 372,436 pounds of UF_6 at the site which will last about 60 days at a feed rate of 6000 pounds per day. The

supplier is currently shipping his entire production of UF_6 to the K-25 plant, at a contract rate of 6000 pounds per day. In addition to the above, there are approximately 250,000 pounds of S-50 waste averaging about 0.68 percent U-235 available for use as emergency feed, which will last approximately 30 days.

4. Provision for Future Requirements

a. General - Every precaution has been taken to insure a continued supply of special mechanical equipment and coded chemicals. Commercial manufacturers of both mechanical and chemical products have entered into standby agreements to go into production upon request.

b. Equipment in Standby - In connection with numerous standby agreements, government owned equipment, tools, jigs, dies and fixtures have been stored in manufacturers' plants for possible future production. (Examples - Crane Valve Company, Allis-Chalmers Manufacturing Company, Taylor Instrument Companies, and Chrysler Corporation.)

c. Status of Government Owned Supply Plants - The barrier manufacturing facilities at Decatur, Illinois and Buffalo, New York are in standby, and could start production within several months in the event that unforeseen difficulties should require replacement of large quantities of barrier.

The Government owned plant constructed and equipped at Milwaukee, Wisconsin for production of K-25 blowers and seals by the Allis-Chalmers Manufacturing Company has been sold to Allis-Chalmers, and all equipment has been disposed of. This eliminates the obligation of the Government to dismantle and remove the facility from the company-owned property.

Specialized machinery and equipment formerly used in the manufacture of stage diffusers by the Chrysler Corporation at Detroit, Michigan is now being maintained in standby storage at a Government warehouse for future use if the need should arise.

KFL lubricant manufacturing facilities formerly operated by the Hooker Electrochemical Company at Niagara Falls, New York have been shut down. An investigation is being made to determine the feasibility of transferring to the K-25 site essential portions of the equipment which could be operated if the need for additional amounts of this

material should arise in the future.

Facilities for the manufacture of 21-4 lubricant and 816 coolant formerly operated by Du Pont in Wilmington area have been dismantled and disposed of.

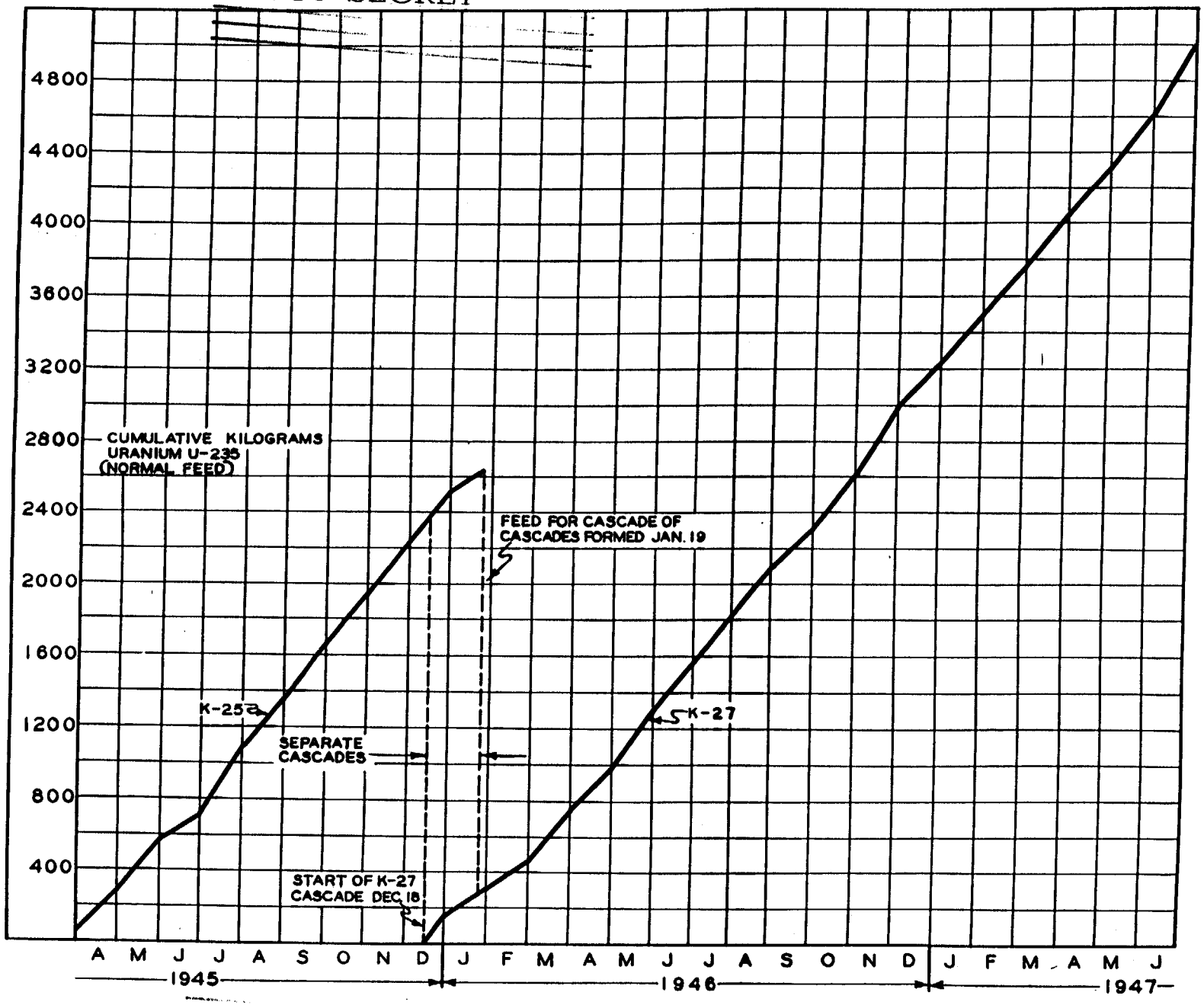
Essential portions of the manufacturing equipment formerly operated by the Linde Air Products Company at Tonawanda, New York for the production of KFP-10 plastic are being transferred and installed at the K-25 site to provide for a continued supply of this material in accordance with future needs of the project.

d. Plants Currently Producing - The only plant currently producing special material for the gas diffusion plant is the Harshaw Chemicals Company, Cleveland, Ohio, where uranium hexafluoride feed material is manufactured.

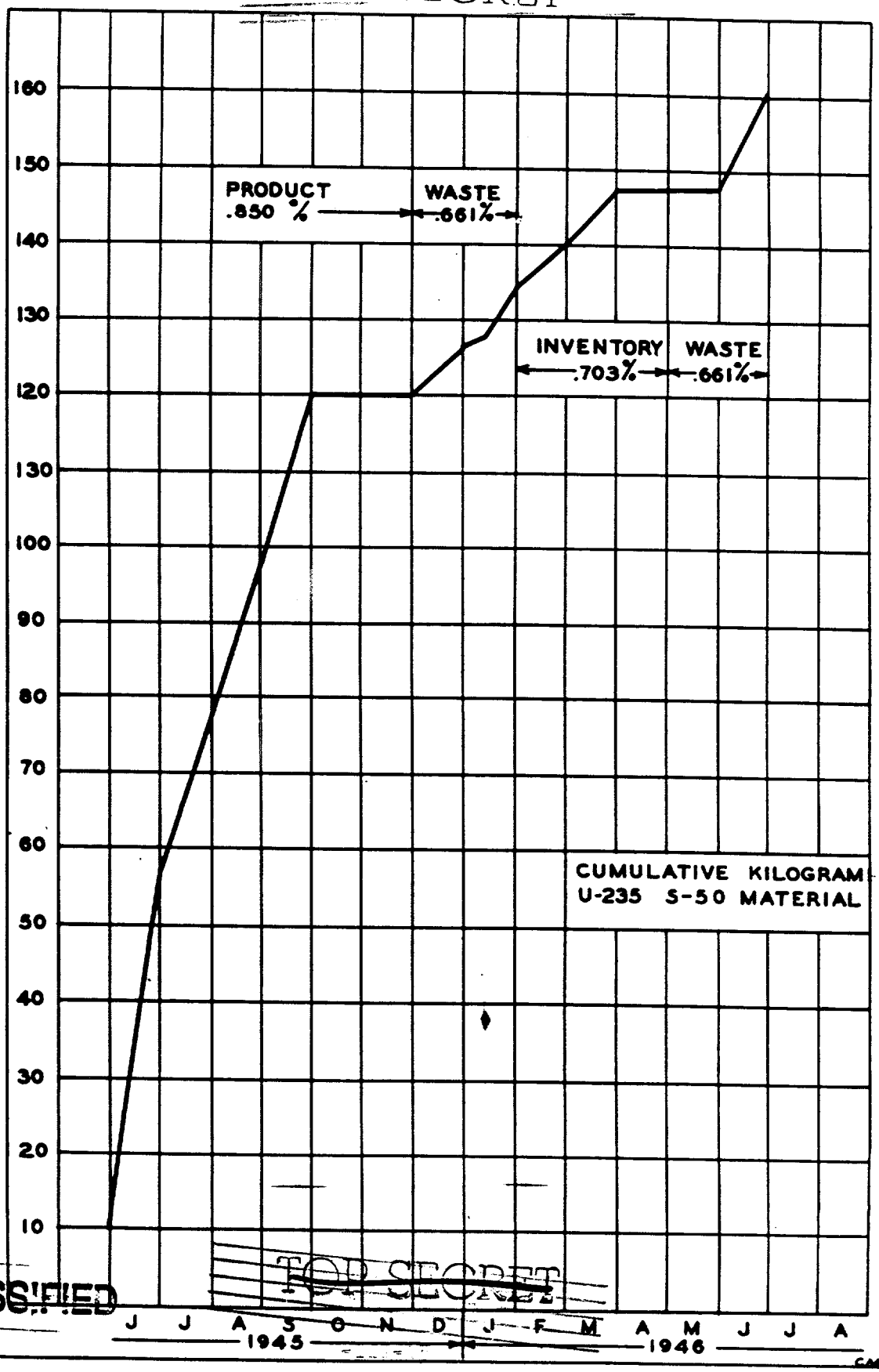
D. S-50 Thermal Diffusion Plant

Shortly after V-J Day the operation of the S-50 thermal diffusion plant, which is located immediately adjacent to the K-25 power plant, was stopped, and the plant was placed in standby condition by the operating contractor, The Fercleve Corporation of Cleveland, Ohio. After the plant had been placed in standby, the maintenance, fire, and guard protection of it were turned over to Carbide, who agreed to perform services as directed by the Contracting Officer.

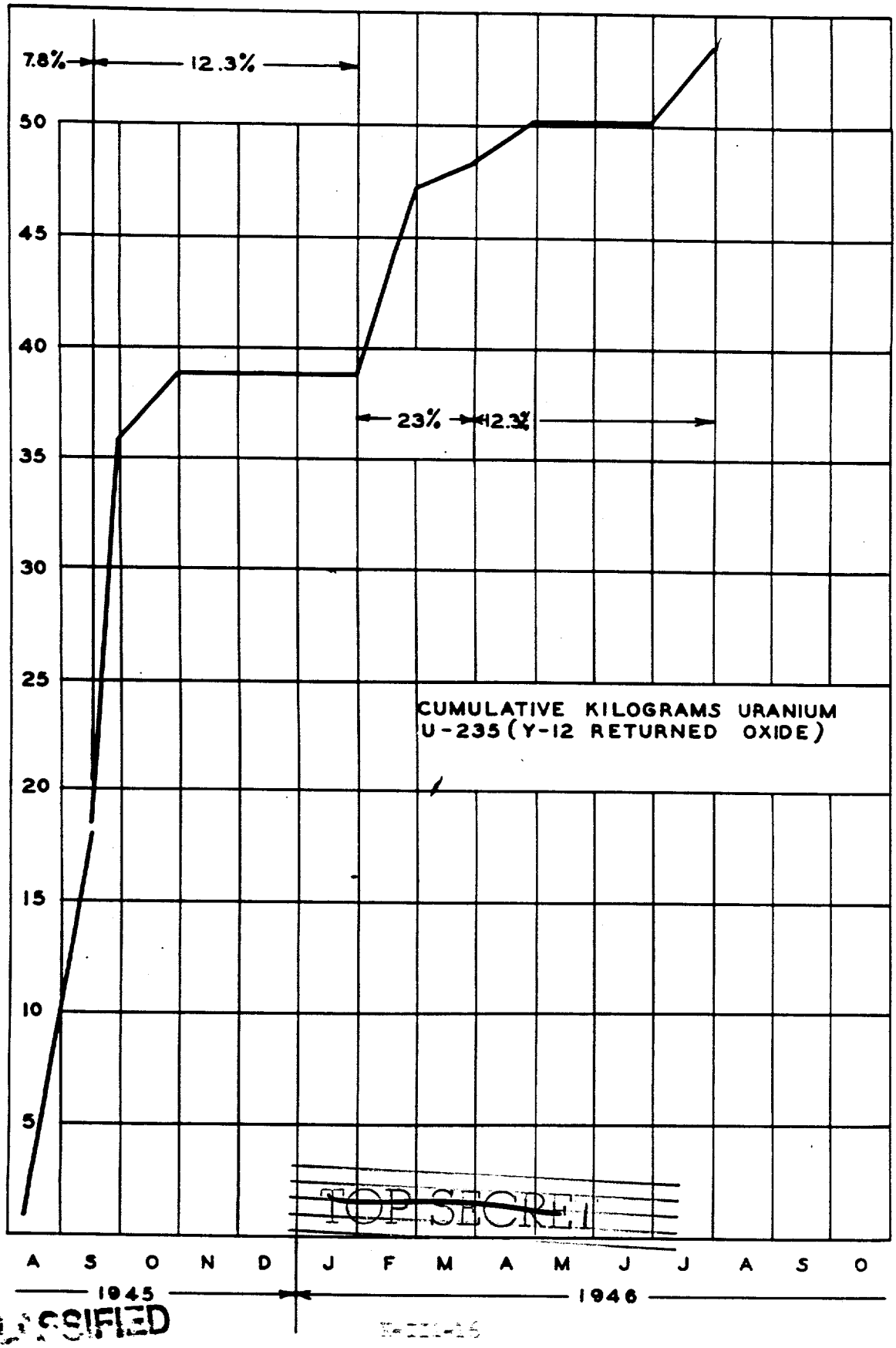
NORMAL FEED TO K-25 AND K-27 PLANTS



S-50 MATERIAL FED TO K-25 AND K-27 PLANTS



Y-12 OXIDE FED TO K-25 AND K-27 PLANTS



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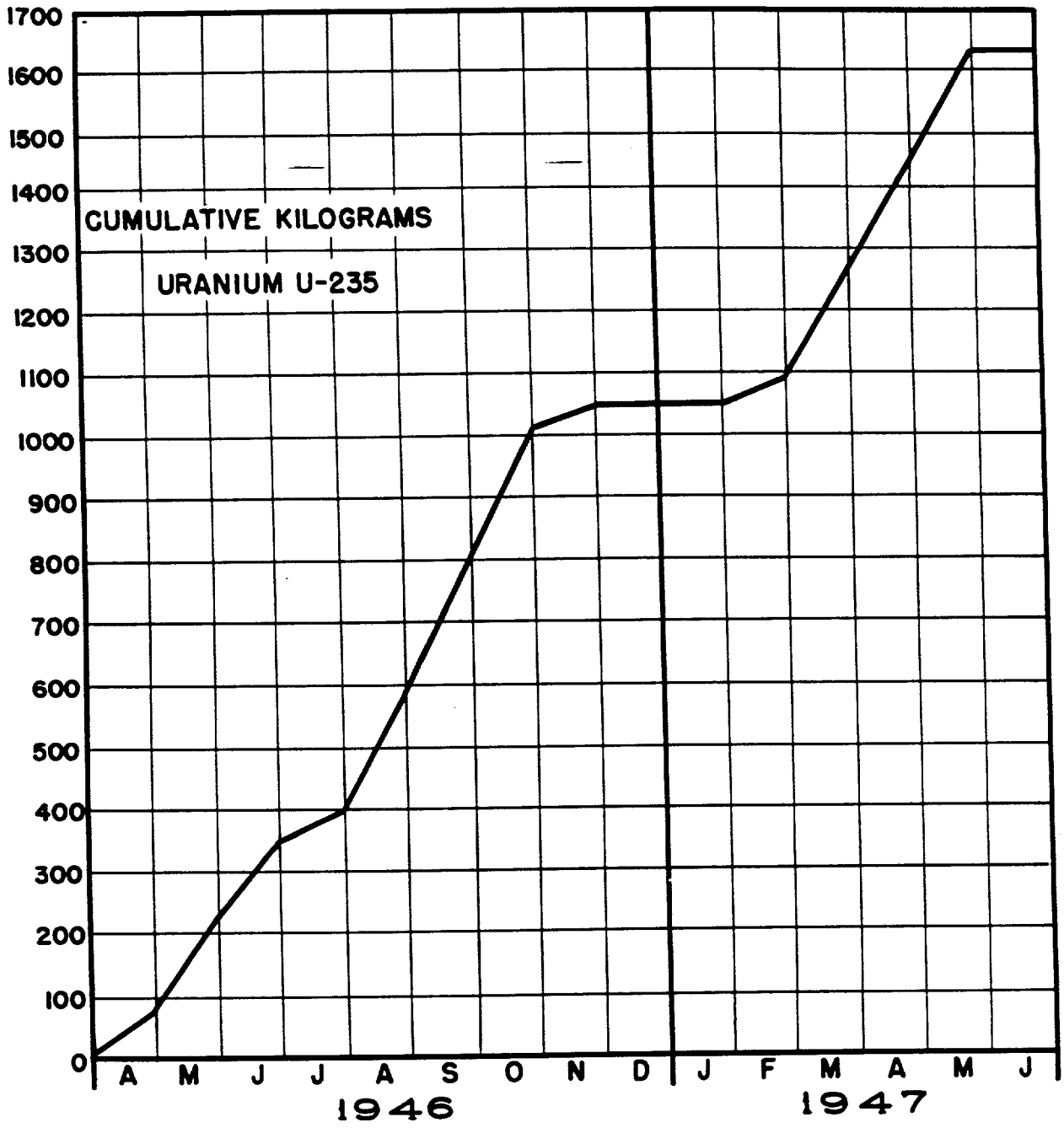
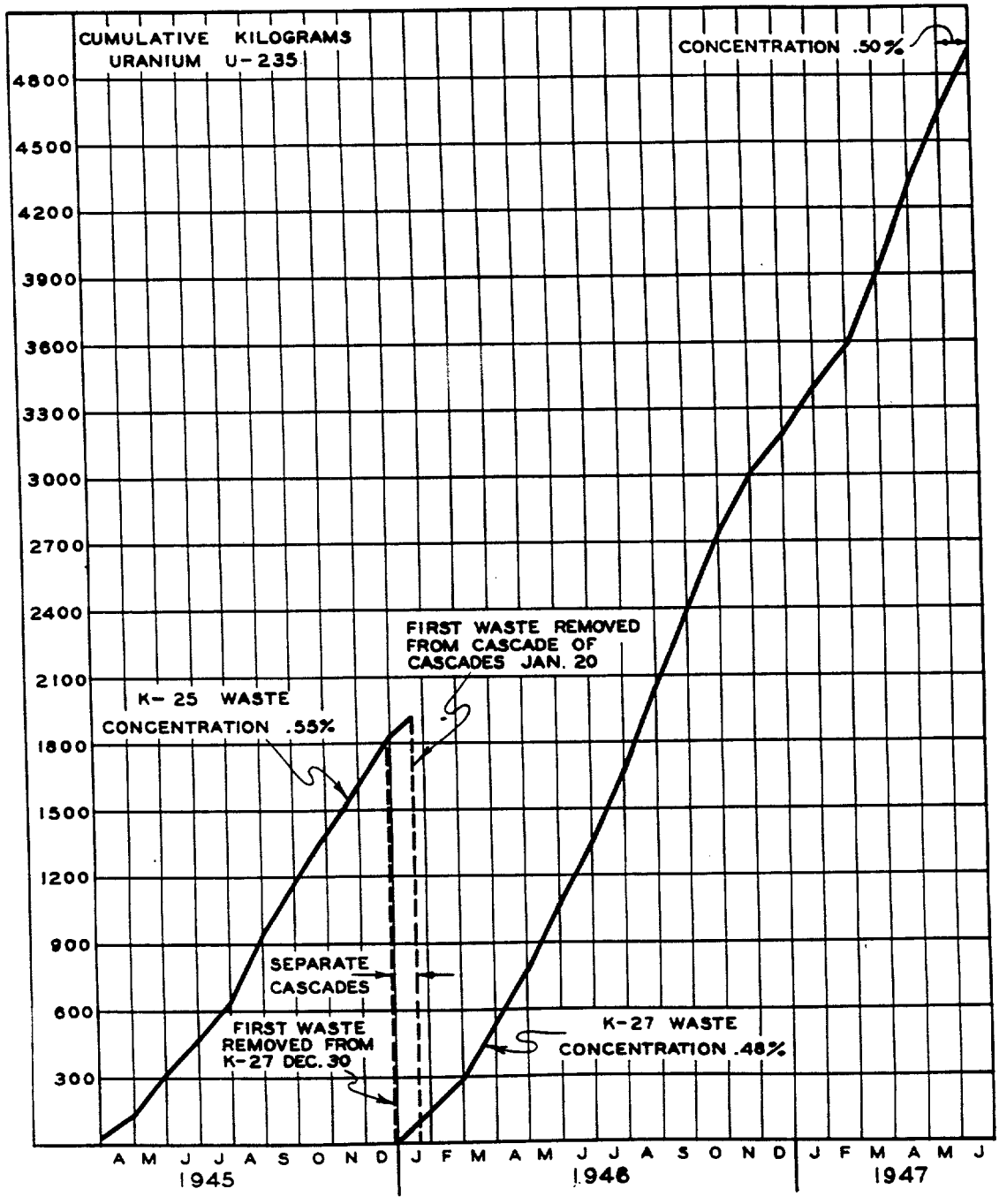
K-25 WASTE FEED TO K-25 AND K-27 PLANTS



WASTE PRODUCED BY CASCADE



IV. RESEARCH, DEVELOPMENT, AND FUTURE PLANNING

A. Research and Development

1. Barrier Research - $448,000 was appropriated to continue work over a twelve months' period starting March 15, 1947 for barrier research. The preparation, stabilization, and evaluation of improved barrier types will be studied.

2. Chemical Research - $358,000 was appropriated to continue work over a twelve months' period starting March 15, 1947 for chemical research. The following subjects will be studied: the basic chemistry involved in conditioning and plugging of barrier, methods in analytical chemistry, the properties and preparation of fluorocarbons, and the metallurgy of plant materials, the chemistry and properties of uranium compounds.

3. Physical Research - $269,000 was appropriated to continue work over a twelve months' period, starting March 15, 1947 for physical research. The following subjects will be studied: critical mass, the improvement of the mass spectrometer, the determination of the absolute isotopic composition of uranium and other elements, the development and adaptation of radiation detection instruments, and radioactive tracer techniques.

4. Engineering Development - If present requests are approved total authorizations for currently active engineering development projects will amount to $820,000. Such problems as follows will be investigated: the study of major revisions and additions to the K-25 plant, separation performance studies, the determination of the consumption of uranium hexafluoride in the cascade, the development of improved types of equipment, the recovery of plant wastes, the operation of the 20-stage pilot plant, the design of a proposed pilot plant, and the development of special instruments.

B. Barrier Replacement Program

1. Present Type of Barrier in Plant - 6% of the original barrier in the plant was composed of DA manufactured by a plant constructed for this purpose at Decatur, Illinois, and operated by the Houdaille-Hershey Corporation. This plant at present is in standby condition. An improved type of barrier, BDA, was developed at Decatur before the completion of the K-25 plant, and the remainder of

the barrier installed in the plant, approximately 36%, was of this type.

Other research and development carried on during the construction of the K-25 plant resulted in barrier production facilities at Tonawanda, New York which were operated by the Linde Air Products Company. Sufficient quantities of barrier tubes were manufactured to equip approximately one building with WB barrier, and 30 additional converters each with TL, WB, and WL type barrier. This plant also is in standby status.

2. Converters Replaced With Improved Type of Barrier - Studies made during operation of the plant at 30% product concentration indicated that if the BA barrier, which comprised of the total barrier in the plant, were replaced with improved types of barrier (BDA, WB, WL, TL) the plant productivity would be increased . On this basis, and to test the efficiency of WB, WL, and TL types of barrier under actual operating conditions, a barrier replacement program was started which is summarized below:

a. Installation of 90 converters in K-27 between November 1, 1946 and February 1, 1947:

Number	Type Barrier	Location	Size
30	WB	402-3	2
30	WL	402-3	2
30	TL	402-4	2
90			

These 90 converters were previously tubed with WB, WL and TL barrier at the K-25 plant during the latter part of 1946.

b. Installation of 216 converters in K-25 between October 16, 1946 and February 28, 1947.

Number	Type Barrier	Location	Size
54	BDA	311-1	3
30	BDA	310-1	2
48	BDA	310-2	2
48	BDA	310-3	2
36	BDA	309-1	1
216			

90 of the above converters were transferred from K-27, the remaining 126, were obtained from spares in storage.

e. Installation of 210 converters in K-25 between March 25, 1947 and May 27, 1947.

Number	Type Barrier	Location	Size
6	WB, WL, TL *	301-4.5	1
30	BDA	309-2	1
18	BDA	309-3	1
42	BDA	302-1	2
60	BDA	302-2	2
48	BDA	302-3	2
6	BDA	303-2.1	2
210			

* 6 converters - 3 WB, 2 TL, 1 TL and 1 WL

92 of the above converters were obtained from spares in storage, the remaining 118, were retubed at the K-25 plant. An additional 49 converters were retubed with BDA type barrier, and placed in storage for use as spares.

C. Barrier Pilot Plant

The plant contains 3432 converters of which 1410 (41%) are considered to be substandard (DA). In addition, there are 736 converters containing substandard barrier, or otherwise unusable, in stock, and 395 spare shells without tubes in stock.

$750,000 has been appropriated to cover the cost of transferring part of the present barrier manufacturing equipment located at Tonawanda and Decatur to the K-25 plant. Also, a sum of $1,850,000 has been appropriated for replacement of the 689 stages with TL type barrier including the manufacture of these tubes

As a first step in this program, the retubing of 78 unusable converters has been approved.

Following the retubing and installation of the 689 converters, the barrier replacement program will again be reviewed for replacement of the converters containing DA type barrier then remaining in the cascade.

Under this program, the Decatur and Tonawanda facilities will not be closed out, but part of the equipment they contain will be utilized at K-25 to permit improvements in present methods of manufacturing barrier, to facilitate large scale development of better barrier, and to provide high quality barrier for the plant.

D. Special Studies

The Atomic Energy Commission has been utilizing the services of the Carbide and Carbon Chemicals Corporation technical staff in making preliminary engineering studies on several problems not directly related to the Clinton Production Division. These problems, as listed below, are currently being investigated by properly authorized personnel in the Carbide organization.

1. Metal Production Studies

a. To make a study of the available facilities at the Y-12 plant, and of the present U-235 metal production and fabrication plant at Site Y; the results of such a study is to determine the feasibility of providing metal production facilities for U-235 at the Clinton Engineer Works.

b. To prepare a preliminary design for an improved plant for the production and fabrication of plutonium metal. This design is to be based on the general process scheme, and the established chemical and metallurgical methods presently employed at the DP West Plant at Site Y. The information will be used by the Commission in studying the feasibility of locating this work elsewhere.

2. Hanford Waste Recovery Problem - Carbide has recently received authorization to establish a review group of three persons whose functions are to review all the available data on the previous work done on recovering Hanford waste material, and to determine how K-25 and Y-12 could give assistance to the Hanford metal recovery program.

3. Operational Study - K-25 - HEW And Evaluation Of The Effects Of Additional K-27 Stages At The K-25 Plant - Preliminary studies have been made by Carbide pertaining to operation of K-25 and Hanford Engineer Works. It is believed that the information developed in the preliminary studies will furnish a picture of the possibilities for operational coordination between K-25 and HEW, and will assist in defining the limits and establishing data required for any further studies that may be desired.

E. S-50 Plant, Thermal Diffusion Process

The S-50 plant has been in shut-down status for 22 months, the operation thereof being discontinued shortly after V-J Day. A survey was made late in 1946 to determine the condition of the equipment and piping, as well as the need for this process in future plans.

On June 10, 1947, the dismantling of the main process building, S-50 area, was authorized. Work is to be performed by the J. A. Jones Construction Co., Inc., under a supplement to its present contract W-31-109-eng-39, and administered by the Chief, Clinton Laboratories Division. All materials which can be sold for an amount greater than the additional cost of preparation for sale will be salvaged. The work is estimated to cost $1,377,000 and is to be completed by December 31, 1947.

This decision is based on the above-mentioned investigation, which indicated the need for a considerable periodic expenditure in the event that the S-50 plant should be continued in standby status without serious depreciation of equipment, upon consideration of savings resulting from the elimination of security protection for the building, upon operational coordination considerations, (which showed that an approximate rise of 2% could be obtained in K-25 production by concurrent operation of S-50, whereas, an estimated increase in total operating costs of 20% would result), and upon the fire hazard due to the combustible siding which forms the covering for the S-50 process building. The possibility of a serious fire in this area, which is immediately adjacent to the K-25 power plant, would thus present a threat to continuous operation of the gaseous diffusion plant.

PART 2 - Y-12 ELECTROMAGNETIC PROJECT

I. BRIEF HISTORY

A. Background

Between December, 1938 and early 1942 it had been established that an isotope of uranium, U-235, was fissionable, and a possible chain reaction was feasible. Various methods were considered for separating the isotopes so as to procure the U-235 in a more concentrated form.

The feasibility of an electromagnetic process for isotope separation grew out of work done by Dr. A. J. Dempster, who, as early as 1918, first used a simplified mass spectrograph, and later work by Dr. E. O. Lawrence, who, by December 6, 1941, had been able to produce a microgram of relatively pure U-235.

The research and development of the electromagnetic process was initiated and developed under the auspices of the Radiation Laboratory of the University of California at Berkeley. The design and engineering was done by Stone and Webster Engineering Corporation.

The following are the principal contractors concerned with the electromagnetic project:

Radiation Laboratory, University of California - Research and Development - W-7405-eng-48
Stone and Webster Engineering Corporation - Design, Engineering, and Construction - W-7401-eng-13, W-14-108-eng-49, W-14-108-eng-60
Tennessee Eastman Corporation - Plant Operation - W-7401-eng-23 (Superseded by Carbide and Carbon Chemicals Corporation - W-7405-eng-26)

B. Purpose

The Y-12 Electromagnetic Plant was constructed to separate the U-235 isotope from a uranium halide. In this process, the halide is vaporized and made to pass through an ionization chamber. The ions of the various uranium isotopes with the same electrical charge, but different masses, pass out of the ionization chamber and are accelerated by a high electric potential in a vacuum chamber, through a magnetic field. The accelerated ions have approximately

the same kinetic energy, therefore, different velocities, and different momenta. The magnetic field exerts a force perpendicular to the motion of the charged particles, such that the ions of U-235 and U-238 follow different circular arcs, with the lighter ions following a path with a somewhat shorter radius than the heavier ions. The ions are most widely separated after completing a semi-circle. The maximum separation of U-235 and U-238, when the path in the magnetic field has a radius of four feet, is approximately 1.5 centimeters. To obtain the U-235 in large quantities, it was necessary to have a very large number of ionization chambers and auxiliary units. There are 1440 vacuum tanks with 3264 ion beams for both Alpha and Beta stages or steps.

The initial plant consisted of five "Alpha", or first stage, magnets or "racetracks", each containing 96 separation units, and two "Beta", or final stage, magnets, each containing 36 separating units. This was increased with changes in design, eventually to a total of nine Alpha and eight Beta. A considerable number of auxiliary buildings, including the essential chemical processing facilities, completed the project.

Originally it was intended that the electromagnetic process should produce 100 grams of U-235 per day. Subsequently, it was decided to increase the size of the plant by adding other Alpha and Beta units until a production capacity of 300 grams per day could be attained.

One of the earlier schedules set up was summarized in a letter dated July 31, 1944. This schedule called for 9.1 kilograms U-235 by the end of December 1944, 46.7 kilograms by the end of July 1945, and 74.2 kilograms by the end of September 1945. The actual production was 8.7 kilograms by the end of December 1944, 61.3 by the end of July 1945, and 104.5 kilograms by the end of September 1945.

C. Research and Development

Physical research, dealing with the design and operation of the mass spectrograph for separating U-235 from U-238 was performed principally at the University of California Radiation Laboratory. The Alpha I prototype was producing material enriched to 9.0% U-235 by May 1, 1943. Improvement programs had the Alpha I units operating at a 25% higher rate by January, 1944. Some Beta spectrograph studies were continued

at the Y-12 Site under the direction of UCRL Staff after May 1, 1943. In June 1943, research on the electromagnetic process was being carried on chiefly at UCRL and Brown University under OSRD contracts. The Tennessee Eastman contract provided for research, but its principal provisions called for the operation of a full sized separation plant. This contract was signed on June 7, 1943, effective as of January 6, 1943. The Brown University contract was taken over by the Manhattan District on April 16, 1943. Administration of this contract was first the responsibility of Madison Square Area, later Chicago Area, and finally, in September 1944, the Y-12 Operations Officer. Purdue and Johns Hopkins Universities began studies of recovery methods for the Y-12 plant in December, 1944 and February, 1945 at the request of the Y-12 Operations Officer. These contracts had originally been administered by the gaseous diffusion plant Operations Officer. Costs of the research work totalled about $19,500,000, of which over 90% was spent at UCRL.

Preparation of charge material had been one of the major problems since the start of the project. UCRL and Brown University developed fairly satisfactory methods by June, 1943. Continued studies by these universities and by Tennessee Eastman Corporation and Purdue University resulted in a liquid phase method that had some advantages over the previous method. Research has continued on this problem to the present, to improve the method, to reduce costs, and to produce a more satisfactory feed. A vapor phase process is now employed.

A principal chemical study has been concerned with the problem of recovering the un-ionized and diffused portion of the process material, amounting to from 75 to 90% of each charge, which condenses on the tank walls and various parts of the equipment.

Throughout 1944, 1945, 1946, and until May, 1947, Tennessee Eastman Corporation continued research on all aspects of the electromagnetic process. This research included a very large amount of work on chemical production, chemical recovery, and recovery from salvage.

D. Design and Engineering

In June, 1942 plans were formulated for the organization of the Manhattan Project, which called for the engagement of a large contracting firm to represent the District in the field of design, procurement of material, and construction of facilities for an overall project based on the researches done at UCRL under the direction of Dr. E. O. Lawrence.

Stone and Webster Engineering Corporation was selected as the Architect-Engineer-Construction firm. The first contract, W-7401-eng-13, became effective June 29, 1942. This contract included Architect-Engineer-Management service to do all things necessary for the following purposes: completion of the required research, design, procurement, inspection, and expediting of material and equipment for certain plants; the initial procurement of essential material; the operation of the plant; the construction of the plant and other facilities.

Top key personnel and specialists of Stone and Webster were sent to the University of California Radiation Laboratory to study the process and work out designs of equipment for incorporation in the Y-12 plant, which they were to design and construct. They were also to collaborate and cooperate with the Radiation Laboratory, the District, and the Tennessee Eastman Corporation, which had been selected to operate the electromagnetic plant when built.

From 1942 through 1945, the designs of the plant equipment were perfected and contracts with other manufacturing companies were awarded for producing the many items required. In most cases the development of the equipment was carried out jointly by Stone and Webster, Tennessee Eastman Corporation, and the cooperating contractors. A partial list of manufacturers follows:

Contractor	Scope of Work
Westinghouse Electric & Mfg. Co.	Bins, Doors, Collector Boxes, Cold Traps and Diffusion Pumps
General Electric Company	Electrical Control Equipment, Meters and Electronic Vacuum Tubes
Allis Chalmers Mfg. Company	Magnet Coils and Electrical Equipment
Chapman Valve Mfg. Company	Vacuum Valves and Manifolds
Distillation Products, Inc.	Diffusion Pumps
Link-Belt Company	Door Handling Equipment
Kinney Manufacturing Company	Vacuum Pumps
Sharples Corporation	Super Centrifuge Bowls and Equipment
Coors Porcelain Company	Insulators and Bushings
Fansteel Metallurgical Corporation	Tantalum Filaments and Equipment
Benner and Newman	Main Door Liners
Corning Glass Works	Glass Equipment, Tubing
Crane Company	Special Valves

Contractor	Scope of Work
Federal Telephone and Radio Corporation	Calsiners and Electronic Tubes
Oliver United Filters, Inc.	Filters and Presses
Bristol Company	Metering Devices
Kerite Wire and Cable Company	Electric Cable
National Carbon Company	Graphite
International Graphite and Electrode Company	Graphite
Leeds and Northrup Company	Potentiometric Devices
Linde Air Products Company	Liquid Nitrogen and Equipment
Higgins, Inc.	Fabrication of Graphite
Air Utilities Corporation	Fabrication of Graphite
Precision Parts Corporation	Fabrication of Graphite
Okonite Company	Electric Cable
Simplex Wire and Cable Company	Electric Cable
General Cable Company	Electric Cable
Glascote Products, Inc.	Glass lined Equipment
Duriron Company	Acid Proof Equipment

E. Construction

Construction of the electromagnetic plant was begun in February, 1943, with Stone and Webster Engineering Corporation as the principal contractor. Their work was covered by three contracts, W-7401-eng-13, W-14-108-eng-49, and W-14-108-eng-60. To expedite the completion of the facilities, the Government executed 65 contracts with 29 different vendors, usually in amounts exceeding $100,000. Stone and Webster let 68 subcontracts among which was one with Watson-Flagg Engineering Corporation for electrical installation amounting to $11,988,685.00, and one with Hanley and Company for piping and mechanical installation work amounting to $7,417,858.00.

The first process building was turned over to the operating contractor in March, 1944, and the last Y-12 building was completed in November, 1945. As soon as a portion of a building was completed so that operations could start, that portion was turned over to the operating contractor. The magnitude of the construction job in Y-12 is indicated by the following tabulations of material:

Item	Quantity
Excavation	1,000,000 Cu. Yds.

Item	Quantity
Concrete	275,500 Cu. Yds.
Lumber	37,562,000 F.B.M
Brick	4,900 M
Concrete Blocks	6,000 Ea.
Tile, Structural	5,284,000 Ea.
Corrugated Asbestos	146,000 Sq. Ft.
Wall Board	2,332,000 Sq. Ft.
Asphalt Shingles, Roofing	486,000 Sq. Ft.
Built-Up Roofing	1,957,000 Sq. Ft.
Windows	13,180 Ea.
Doors	4,400 Ea.
Precast Roof Slab	82,000 Sq. Ft.
Asphalt Tile Floor	26,600 Sq. Ft.
Sewer Lines	61,500 L.F.
Water Mains	55,000 L.F.
Steam Mains	28,600 L.F.
Crushed Lime Stone	554,000 Tons

A total of 12,000 workers were employed on the electromagnetic project during the month of June, 1944. This had been the average for approximately eight months.

F. Operation

The Tennessee Eastman Corporation was selected to operate the electromagnetic plant. A letter of intent was drafted on January 6, 1943, and served as a contract until June 7, 1943, when negotiations for formal Contract W-7401-eng-23 were completed.

The Tennessee Eastman Corporation advised on design, and operated the pilot plants, XAX and XEX prior to their acceptance of the first track in the Alpha I buildings. Eastman also took over the vacuum testing of process equipment after installation by the construction contractor.

Operation was begun in the several process buildings on dates shown in the following table:

Alpha Track No. 1 - November 13, 1943 (1st Temporary Start)
- March 3, 1944 (Restart)
Alpha Track No. 2 - January 22, 1944
Alpha Track No. 3 - March 19, 1944
Alpha Track No. 4 - April 12, 1944
Alpha Track No. 5 - June 3, 1944
Alpha Track No. 6 - July 24, 1944

Alpha Track No. 7 - August 26, 1944
Alpha Track No. 8 - September 24, 1944
Alpha Track No. 9 - October 26, 1944
Beta Track No. 1 - March 15, 1944
Beta Track No. 2 - June 5, 1944
Beta Track No. 3 - September 12, 1944
Beta Track No. 4 - November 2, 1944
Beta Track No. 5 - January 30, 1945
Beta Track No. 6 - December 13, 1944
Beta Track No. 7 - December 1, 1945
Beta Track No. 8 - November 15, 1945

The Chemical Engineering, Process Improvement and Auxiliary buildings kept apace and were, as a rule, ready for use as they were needed for operations.

II. PRINCIPAL OPERATING CONTRACTS

The Y-12 plant was operated by the Tennessee Eastman Corporation until May 4, 1947, at which time the responsibility for operation was transferred to Carbide and Carbon Chemicals Corporation.

A. Scope of Original Contract

The original contract, W-7401-eng-23 with Eastman, provided for the following work under the titles listed:

Title I required the contractor to provide consultant services regarding the design, engineering, and construction of all features of the buildings, and regarding equipment and auxiliary services pertaining to the plant. A fixed fee of $1.00 constituted compensation for this title.

Title II provided that the contractor obtain and train key personnel for the operation of the plant. Compensation for this title was set at a fixed fee of $1.00.

Title III provided that the contractor would perform, and arrange for performance of, such research and development work, for process and product improvement, as was deemed necessary or advisable, so that final product of suitable specification and quality could be produced. Fixed fee for this title was $1.00.

Title IV provided that the contractor would undertake all preparation necessary for the operation of the plant, including training of personnel for such operation, in addition to the training of the key personnel mentioned in Title II. Upon completion of the various process buildings, the contractor would undertake to operate such buildings to their maximum capacity, so as to prepare a product of desired specification. Under this title (later amended) the contractor was to be paid a fixed fee of $75,000 per month, less a deduction of $7,500 for each production unit, or magnet, not in operation during that month.

Title V contained provisions for reimbursement of the contractor for all actual expenditures made in the performance of the work called for by this contract, including, but not limited to, the following items:

All labor, material, tools, machinery, equipment, facilities, supplies, communication charges, services,

utilities, power, and fuel necessary or appropriate for either temporary or permanent use in the benefit of work.

All sub-contracts made in accordance with the provisions of the contract.

Transportation charges, loading, unloading, and storage charges on materials and supplies.

All expenditures actually incurred arising out of the moving of personnel to and from work, including their families and household goods.

Title VI provided for the termination of the contract in whole or in part, either by reason of default, or for the convenience of the Government, and defined the obligations, liabilities, and rights of both parties in the event of such termination.

Title VII described the responsibility of the contractor limited to the conducting of its operations in good faith, with no warranty of the success of either design, operation, or product. The term of the contract was set forth as extending from January 6, 1943 to six months after termination of hostilities with the Axis Powers. (The term was later extended, by Modification No. 7 to June 30, 1947.)

Title VII also set forth the annual estimate of costs, provided for the procurement of expert technical, medical, or other professional assistance, the delivery of technical data, drawings, notes, designs, and specifications to the Government, the keeping of records and accounts, inspection, and audits, prohibited the use of convict labor, and included a number of other miscellaneous items.

B. Principal Supplements to Original Contract

On August 15, 1943, the contract was supplemented to permit the contractor to perform auxiliary services for the operation of the town of Oak Ridge, at the Clinton Engineer Works and elsewhere, and to permit employment of personnel in these services to facilitate serving the entire Clinton Engineer Works, until the District should procure the services from other sources.

On May 5, 1944, by reason of the expansion of the plant, provision was made for enlarging the scope of the contractor's work. The fix-fee basis was changed to $22,500 per

month plus $7,500 for each production unit operating during the month, up to a maximum of seven such units, and $4000 for each unit in excess of seven which shall have been operating during such month. This supplement also provided for placement of patent applications and the assignment of licenses and sub-licenses to and by the contractor; provided that the contractor, in performance of the work required by the contract, shall not discriminate against an employee or applicant for employment because of race, creed, color, or national origin; and provided for utilization of the services of members of the Armed Forces under certain conditions.

On December 28, 1945, the scope of the Contractor's research and development work was enlarged, the terms of the contract were redefined, and the Government was granted an option to renew the contract for an additional period of twelve months; an equitable basis was provided for reimbursing either party for possible losses sustained by virtue of the application of variable compensation rates provided for under the Tennessee Unemployment Compensation Law.

On March 11, 1946, the cost of Contract W-7401-eng-23 was limited to $264,000,000 inclusive of the fee, and the cost of closing out the contract was limited to a maximum of $31,000,000.

On March 15, 1946, the contractor agreed to furnish such of its personnel as might be mutually agreed upon to render certain services in connection with Operations Crossroads.

On April 22, 1946, the contract was modified to provide for expert advice in connection with labor relations, including hearings or proceedings before the National Labor Relations Board or any successor Government Board or Agency.

C. Current Operating Contract

Supplemental Agreement #19 to Contract No. W-7405-eng-26 (see Part I) was entered into on March 24, 1947, by and between the United States of America and Carbide and Carbon Chemicals Corporation. It provided that:

The Contractor (Carbide and Carbon Chemicals Corporation) shall take over and operate the Y-12 plant so as to:

a. Separate stable isotopes.

b. Operate one Beta track with necessary auxiliaries primarily for development purposes.

c. Perform final chemistry for processing K-25 and K-27 product and such product as is produced in one Beta track in the Y-12 plant.

d. Conduct process improvement and development work with regard to the operation of the Y-12 plant.

e. Furnish all materials, supplies, and services necessary for the maintenance in standby condition of all parts of the Y-12 plant which are not being used by the contractor in its operations and activities.

The contractor was authorized to reconcile its wage and salary schedules with those of Tennessee Eastman Corporation, to extend its company service credit to those employees of Tennessee Eastman Corporation who shall become employees of the contractor, and to make such payment of return travel expenses of an employee and his family as would be proper if he had been hired by and been employed by the contractor, and to employ individuals and use them in a training status.

The estimated cost of work under the supplement is approximately $830,000 per month exclusive of fixed fee, and exclusive of cost of feed for Y-12 plant operations.

The contractor shall be reimbursed for costs incurred and shall be paid a fixed fee of $19,000 per month.

III. STATUS OF ELECTROMAGNETIC PROJECT AS OF JUNE 30, 1947

A. Operations

1. Initial Operations - During the latter part of 1943, the Alpha Section (XXX) in the Pilot Plant, Building 9731, was in operation. Vacuum testing started August 7, 1943 with nine men on three shifts. This operation had for its primary objective the training of the initial personnel required to operate the Alpha I buildings and the acquisition of as much knowledge as possible of the equipment and its characteristics; for organizational purposes, it was also necessary to acquire a knowledge of the personnel, their abilities, and their characteristics.

2. Production Operations - The several production units were placed in operation, beginning on January 22, 1944 and continuing as indicated in Paragraph I-F. Two years and two days elapsed between the starting of Alpha Track No. I and Beta Track No. 8.

a. Feed - The feed material for the Alpha Stage was received by year as indicated below:

Year	Kg. U-235	% U-235	Kg. U
1943	53.28	.71	7,505.58
1944	907.88	.71	127,854.05
1945	779.18	.77 (Ave)	100,621.74
1946	-	-	-
Total	1,740.34	.74 (Ave)	235,979.35

This material for feed was received in the form of trioxide, tetrachloride, dioxide, pentachloride, hexafluoride, a small amount of residues, salvage from Beta, and a large amount of miscellaneous material from U.S.E.D. The chief sources were Mallinckrodt, Harshaw, S-50, K-25 and U.S.E.D.

b. Product - The uranium was removed from the Alpha Cycle as follows:

Year	Kg. U-235	% U-235	Kg. U
1943	-	-	-
1944	425.43	.72	59,488.59
1945	1,314.91	.75	176,480.77

Year	Kg. U-235	% U-235	Kg. U	
1946	--	--	--	
Inventory as of 6-8-46	0.73	.40	184.16	
Total	1,740.34	.74	235,969.36	
Material unaccounted for	842.84	.64	37,726.84	(15.99% of total)

Of the amount removed from Alpha Cycle there was added to the Beta Cycle as follows:

Year	Kg. U-235	% U-235	Kg. U
1943	--	--	--
1944	23.129	11.	210.24
1945	72.728	9.71	749.71
1946	--	--	--
Total	95.857	9.99	959.95

Of this total amount, 3.49 kg of uranium containing .327 kg U-235 was unaccounted in refining oxide. 168,196.96 kg of unused feed material was returned to the U.S.E.D.

The following table shows the production, based on 100% U-235, of the Beta Stage, from the beginning of operations through June 30, 1947:

All production to 0700 January 1, 1945	8,690.1
0700 January 1, 1945 to 0700 Dec. 30, 1945	224,070.3
0700 December 30, 1945 to 0700 Dec. 29, 1946	808,266.1
0700 December 29, 1946 to 0700 July 1, 1947	75,462.6
Total to Date July 1, 1947	1,116,489.1 grams

e. Waste - The waste from process was of three types: one in solution and of such low concentration that it would not be possible to concentrate and recover economically; this was turned over to the Government (U.S.E.D.) to be disposed of by storing in a reservoir for same; the second in solid salvage and so low in concentration that it could not be economically recovered by strong acid or by destructive fluorination of the solids; the third constituting a

relatively small amount that was adhering to equipment in such a manner that it could not be removed without destroying the equipment.

3. Efficiency of Operations - The efficiency of operations is denoted by means of "X Utilization Efficiency" (XUE) and "T Utilization Efficiency" (TUE) which are defined as follows:

$$XUE = \frac{RX}{RX + QX + \text{discarded salvage X} + \text{unaccounted for X}}$$

$$TUE = \frac{RT + QT}{RT + QT + \text{discarded salvage T} + \text{unaccounted for T}}$$

Q - Ionized material received and collected in the U-238 Section, or the "Q pocket" of the receiver.

R - Ionized material received and collected in the U-235 Section, or the "R pocket" of the receiver.

X - Is U-235

T - Is total uranium, formerly referred to as "Tuballoy", and includes all uranium isotopes.

Therefore, RX is X received in R pocket.
QX is X received in Q pocket,
RT is total U found in R pocket, and
QT is total U found in Q pocket.

The utilization efficiencies have run as follows:

Year	XUE	TUE
1944	65.0%	74.0%
1945	80.9%	84.1%
1946	91.7%	93.3%

The overall losses have aggregated 17.4% of the amount received in Alpha Plant and 5.4% of the amount received in the Beta Plant.

The "X Process Efficiency" (XPE) is based on the ratio of the amount of U-235 collected to the amount in the vaporized charge material. XPE has run as follows:

Year	XPE
1945	11.7

UNCLASSIFIED

Year	KPE
1946	14.9
1947	18.3

4. Diversion Control - Protection of the entire plant is afforded by means of a steel fence enclosure with guarded gates. This fence is adequately lighted, and clearance is maintained of all obstructions to vision, including vegetation, for a minimum distance of fifty feet on each side. Access points to the area are held to a minimum, and gates are kept closed until entrance is approved by the guard on duty. A patrol road is maintained around the fence, and is patrolled regularly by an armed guard in a patrol car equipped with a two-way radio. All guard posts are provided with telephone communication facilities, and in addition, certain strategic posts are provided with a two-way radio and emergency magnetic telephone.

There are four inner exclusion areas, each enclosed by a chain link fence; one (Area No. 5) is enclosed by a double line of such fence with gates in both fences, only one of which is opened at a time. Admittance to the various areas is controlled by use of a color coded badge, or by badge exchange.

A study is now in progress to provide increased physical protection for the most critical area (Area No. 5). Serious consideration is being given to the use of an automatic detection device located between the double fences.

A special safeguard is in use in the case of employees where duties require access to highly classified information and/or highly restricted areas. This is in the form of an examination for subversive tendencies by means of the "Keeler Polygraph". Through measurement of an individual's responses to various "leading questions", an indication is obtained of mental stability. The Polygraph has proven to be a great value as an aid in selecting personnel for specialized positions dealing with highly classified information and processes.

Special vaults and safes are utilized for storage of important radioactive and fissionable materials, with strictly limited access. Shipment of such material into or out of the plant is accomplished by representatives of the AEC, except for materials received from, or sent to, the K-25 plant. Shipments between the two plants are handled by especially equipped trucks, under armed guard, and

followed by an armed escort. Both truck and escort are equipped with a two-way radio, and are in constant contact with a central point from which assistance can be dispatched immediately if needed.

Intra-plant movement of such materials is accomplished by especially equipped trucks, with strict safety and security controls. A rigid system of accountability is maintained which would immediately detect any losses.

5. Status of Operations as of June 30, 1947 - Present operations at Y-12 are in accordance with the terms of the Supplement No. 19 to Contract W-7405-eng-26 as indicated in Paragraph II-C:

Track 5 of Building 9204-3 is being used for development work on the mass spectrograph unit. There is only a small amount of final product being produced. This small production is incidental to the primary purpose of the Y-12 program. Furthermore, the feed is to be changed to normal material beginning July 1, 1947.

Isotopes of a large number of elements have already been separated, purified and shipped to other laboratories throughout the country. Still other elements are in the process of separation to supply laboratories with the pure isotopes, and to gain information that is pertinent and valuable for the improvement of the process.

The Beta Chemical Building 9206 is being operated in part to supply feed material for the mass spectrograph, and to recover and purify such research material as is brought in from the process building.

Building 9211 is at the moment maintaining a small group of people engaged in the separation of uranium from accumulated residue. This operation is nearing completion.

Building 9212 is being maintained in full operation to handle the final product from K-25, and any small amount of final product that may be produced in Y-12 in the process of experimentation and development.

Research and development on the process are progressing at a satisfactory rate. For convenience this work may be divided in two classes: physical and chemical.

In physical research, continued studies are being carried on to find out more about ion source phenomena, beam

characteristics, and such instrumentation as is necessary to acquire information and data, and to assist in the interpretation of phenomenon observed. As a result of these studies and the improvements resulting therefrom, XFE's approaching 25% have already been obtained on a number of runs. Average results for 19 runs made in equipment of improved design are as follows:

Charge Consumption Rate	12.1	grams/hour
Actual XFE	24.5	%
Average Q Current	94	milliamps
Production Rate	0.5116	grams/hour

Chemical research is continuing in its effort to simplify the preparation and recovery of uranium in process; also to improve the technique in recovery and purification of the isotope separation in the isotope program.

B. Personnel and Organization of Contractor

A total of 2391 employees were on the Y-12 payroll of the operating contractor as of June 30, 1947. Approximately 28% are females and 72% males. About 10% are college graduates; 20% of this group hold masters degrees.

There are approximately 1610 hourly employees earning an average of $1.33 per hour or $53 per week; 388 non-exempt, earning an average of $94 per week, and 393 exempt averaging $390 per month. Total payroll of the Corporation at Y-12 is approximately $600,000 per month.

A breakdown of personnel showing the number of employees assigned to each division as of June 30, 1947, is as follows:

Administration	282
Operation	676
Maintenance	659
Laboratory and Research	428
Protection	285
Services	143

Labor turnover averaged 1.5% for the month of June.

Employees housed on the reservation total 1157; with 314 in permanent type housing units, 19 in victory cottages and 824 in prefabricated units. The 1234 remaining employees live in dormitories, or outside the reservation. Most of these employees from off area live in Knoxville, Clinton, Harriman,

Rockwood or other towns within a radius of about 60 miles of the Project.

The Carbide and Carbon Chemicals Corporation's Y-12 administrative organization chart is shown on page Y-III-8.

C. Status of Supplies

1. General

a. General - At the present time no difficulty is encountered because of scarcity of supplies. Most of the supplies can be procured through normal channels, on the open market, and on Treasury Procurement orders. Certain greases and lubricants are allocated from Navy purchase contracts. Only one priority was required in the procurement of ordinary standard stock items during the past year.

b. Stockpile - Approximately 57,000 items of Class C property are carried in stock and in the supply stores, irrespective of Alpha and Beta fabricated spare parts. There are approximately 598,000 square feet of storage space, of which 230,000 is outside storage. There are 37 separate buildings, and stores are located in parts of 11 other buildings that constitute the different warehouse locations. In the majority of cases a six months' supply is carried in stock. The inventory value of this class "C" property, including spare Alpha and spare Beta parts, as of June 30, 1947, was $20,638,850.93. The spare Alpha and spare Beta parts amount to approximately $12,000,000.

c. Turnover - Of the above items, approximately 5% of the supply stores are moved in a six months period.

d. Coal - There was an estimate of 13,134 tons, of coal on hand as of June 30, 1947, or approximately 150 days' supply. Considerable difficulty has been experienced in the past in procuring coal. It has been necessary to develop new sources in order to supply the Project; however, this situation has recently eased considerably.

e. Salvage - This Project has made every effort to reduce the number of items for salvage through an extensive maintenance program. Only items that are questionable, damaged, or of obsolete nature are acceptable for a scrap determination. Together with this, all machinings and turnings from the machine shops at the site are delivered to the salvage yard and sold as scrap.

JULY 1620
NON-EXEMPT 384
EXEMPT 395
2399

ORGANIZATION CHART
JULY 1, 1947

PLANT SUPERINTENDENT
C. E. CENTER

Y - 12
SUPERINTENDENT C. N. RUCKER, JR.
J. M. HERNDON — E. C. CAIN
W. D. LAVERS — W. H. ACTON
DR. C. E. LARSON

ASSISTANT TO SUPERINTENDENT
H. C. McBIRNEY
15 Others

SHOPS AND MAINTENANCE DIVISION
SUPERINTENDENT W. H. ACTON
1 Other

- ELECTRICAL EQUIPMENT REPAIR AND MAINTENANCE — SUPERINTENDENT C. HARRILL — 75 Others
- EXPERIMENTAL PROCESS EQUIPMENT MAINTENANCE DEPT. — GENERAL FOREMAN W. MARSHALL — 44 Others
- MAINTENANCE SHOPS DEPARTMENT — GENERAL FOREMAN J. CASE — 103 Others
- GENERAL PLANT MAINTENANCE DEPARTMENT — SUPERVISOR L. MADONNA — 176 Others
- TRANSPORTATION DEPARTMENT — FOREMAN C. B. HOPKINS — 47 Others
- JANITORS DEPARTMENT — GENERAL FOREMAN K. W. MERCHER — 35 Others
- LAUNDRY DEPARTMENT — GENERAL FOREMAN C. McALLISTER — 18 Others
- GARAGE REPAIR SHOP DEPARTMENT — SUPERVISOR Z. C. HUMPHREYS — 17 Others
- PLANNING AND ESTIMATING DEPARTMENT — ENGINEER W. L. MORGAN — 32 Others
- GENERAL UTILITIES AND STAND-BY DEPARTMENT — SUPERVISOR T. CHANEY — 98 Others
- STEAM PLANT DEPARTMENT — ENGINEER A. MORMAN — 22 Others

INDUSTRIAL RELATIONS DIVISION
SUPERINTENDENT E. C. CAIN
1 Other

- MEDICAL DEPARTMENT — MEDICAL DIRECTOR DR. C. R. SULLIVAN — 29 Others
- EMPLOYMENT DEPARTMENT — SUPERINTENDENT H. O. RAMEY — 27 Others
- SECURITY AND SAFETY DEPT. — SUPERINTENDENT T. A. McKENZIE — 9 Others
  - GUARD DEPARTMENT — CHIEF OF GUARDS M. BRADFORD — 139 Others
  - FIRE DEPARTMENT — FIRE CHIEF J. W. HUGHEY — 61 Others
- INDUSTRIAL SERVICES DEPT. — SUPERVISOR H. P. DOYLE — 17 Others
- CAFETERIA DEPARTMENT — SUPERINTENDENT G. J. McNAMEE — 49 Others

CHEMICAL DIVISION
SUPERINTENDENT J. M. HERNDON
12 Others

- CHEMICAL RECYCLE DEPARTMENT — SUPERINTENDENT H. W. SAYLOR — 260 Others
- ANALYTICAL DEPARTMENT — SUPERINTENDENT D. M. CANG — 147 Others
- ASSAY DEPARTMENT — SUPERINTENDENT P. F. HIBBS — 99 Others
- MATERIAL CONTROL DEPARTMENT — SUPERVISOR F. C. UFFELMAN — 40 Others
- PRODUCT CHEMICAL DEPARTMENT — SUPERINTENDENT H. MACKAY — 151 Others

ENGINEERING AND REFINING DIVISION
SUPERINTENDENT W. D. LAVERS
9 Others

- ENGINEERING DEPARTMENT — MECH. ENGINEER F. ZURCHER — GROUP ENGINEER J. C. BOWLES — 55 Others
- REFINING PRODUCTION DEPT. — SUPERINTENDENT G. W. MITCHELL — 218 Others

DEVELOPMENT DIVISION
DIRECTOR DR. C. E. LARSON
1 Other

- ISOTOPE DEVELOPMENT DEPT. — SUPERINTENDENT DR. C. P. KEIM — 65 Others
- PROCESS DEVELOPMENT DEPT. — SUPERINTENDENT DR. R. S. LIVINGSTON — 94 Others
- CHEMISTRY DEVELOPMENT DEPT. — CHEMIST DR. D. C. HILL — 67 Others
- GAGE STANDARDS — SUPERVISOR J. KIRK — 11 Others

MANUFACTURING OFFICE DIVISION
CHIEF ACCOUNTANT F. A. BAILEY

- ACCOUNTING DEPARTMENT — ASSISTANT CHIEF ACCOUNTANT D. W. HARRIGAN — 68 Others
- RECEIVING SHIPPING AND STORES DEPARTMENT — STORES SUPERVISOR W. WATSON — MATERIAL CONTROL SUPERVISOR S. H. SHELTON — 110 Others

LEGEND: SOLID LINE - DENOTES LINE ORGANIZATION TO Y-12 SUPERINTENDENT.
BROKEN LINE - DENOTES LINE ORGANIZATION TO SUPERINTENDENT OF MANUFACTURING OFFICE DIVISION AT K-25.

ORGANIZATION CHART
CONTRACTOR: CARBIDE AND CARBON CHEMICALS CORPORATION Y-12
CONTRACT NO: W-7405-ENG-26
TYPE: C. P. F. F.
APPROVED C. N. Rucker DATE 1-9-47
(For Contractor)
Y-12 SUPERINTENDENT
APPROVED _____ DATE _____
(For AEC)
CONTRACTING OFFICER

f. Excess - Numerous construction and operating supplies continue to be obtained from excess lists circulated throughout the Atomic Energy Commission by various contractors. In turn, Y-12 has been able to furnish a large amount of construction and operating supplies to other contractors. This excess was arrived at by the using departments calculating their requirements on a six months basis, and items were then placed on excess lists to be circulated throughout the District, after which they were turned over to the Surplus Property Officer for sale by the War Assets Administration, to the Storage and Issue Branch for stockpiling, or to the Roane Anderson Salvage Yard for small lot sales.

g. Transportation - Approximately 170 automotive vehicles are used throughout the Y-12 area for movement of material, equipment, and personnel. The vehicles used by the contractor make 47 trips per month outside the CEW perimeter, averaging about 50 miles per trip, and 257 trips per month inside CEW averaging about 15 miles per trip. The five sedans used by AEC in Y-12 average about 5 trips per month outside the perimeter and 100 trips per month inside Oak Ridge.

2. Mechanical

a. General - The greater portion of the refining equipment is of special design, although much of the chemical process equipment is either standard, or adapted from equipment which is standard in the chemical industries. Established manufacturers entered into direct prime contracts with the War Department to produce the necessary special equipment, and did much to assist in working out many of the research and design difficulties. Examples of special equipment developed are the various types of equipment handling trucks, developed by Link-Belt Company for handling of Alpha units. There is a total of 77 trucks of five types, which were employed in the five Alpha Buildings. These trucks were designed to hold, move, and position the units for removal, repair or installation.

b. Techniques - Since many of the materials used in the process had never been extensively applied prior to this work, numerous new techniques had to be developed. This was especially noticeable in the welding and fabrication of stainless steel, and the application of glass and other non-metallic piping.

c. Pumps - Vacuum equipment is one of the major classifications of equipment in the plant. Many types have

been used; there are approximately 1500 Kinney pumps of various capacities; approximately 2850 sets of diffusion pumps, consisting of one large unit (20" to 32" size) plus an 8" booster unit, and small numbers of Nash or Beach-Russ pumps used in special situations.

d. Leak Detectors - As a corrollary to the vacuum equipment, special leak hunting equipment was developed. The two types in use are the General Electric and the Westinghouse units. Both employ the mass spectrograph principle of gas analysis to detect traces of special probe gases used for leak detection. There are 93 of the General Electric type and 36 of the Westinghouse type at Y-12, of which 79 units are in standby condition.

e. Silver - Silver, which is on loan from the United States Treasury, in the bus bars and magnetic coils, totals 403,364,892.58 fine troy ounces, valued at $520,340,711.43, based on a valuation of $1.29/FTO for monetary value of silver. There are 918 silver wound coils in the five Alpha Buildings, two Beta Buildings, and Research Building 9731. There are 22 uninstalled, or standby, magnetic coils. The amount of silver in 940 coils totals 399,449,618.38 FTO. The total amount of silver in the 8863 pieces of installed bus bars in 3,915,274.20 FTO. The conductor material in magnetic coils and bus bars in two Beta Buildings (9204-3 and 4) is copper.

f. Power and Water - At the present level of operations, the Y-12 plant averages approximately 8,500,000 KWH per month of electric power consumption. The water usage rate is about 4,500,000 gallons per day, supplied by the Oak Ridge filtration plant.

g. Special Production Facilities - There is one major manufacturing unit which is being maintained in standby condition for possible future use. This is the Coors Porcelain Company, Golden, Colorado, which supplied high voltage porcelain insulators and bushings.

h. Shop Facilities - The machine shop is uncommonly well equipped with a wide variety of general purpose machine tools. With the associated welding, tool and die, and sheet metal shops, it is able to handle work of considerable size and precision. Equipment in the shop can handle pieces up to 4½ feet square and 6 feet long in the boring mill; parts up to 18 feet long and 45 inches diameter on turning. The Metal Shop can shear 10 foot widths of ½ inch mild steel, and can bend 6 foot widths of ½ inch plate steel. These shops have done considerable work recently for contractors other than Y-12.

The carbon shop, which is a specialized machine shop, employing special techniques necessary to machine carbon, is able to handle all the normal and experimental work now being done. In the event of a substantial increase in work, however, it would be necessary to contract with outside vendors for the fabrication of necessary carbon parts.

3. Special Chemicals - Special chemicals that are used in process in recovery, and in the preparation of feed materials are procured directly by the contractor from regular vendors, through the Office of New York Directed Operations (NYDO), and by direct agreement with Government Agencies and/or by surplus transfer from other Governmental Agencies.

From NYDO such materials are procured as UO_2, UCl_4, gallium, and rare materials that are on stock piling lists of the War Department. In the two cases of helium, which is obtained from the Bureau of Mines, and special castings, from the Naval Gun Factory, the transfer of material from other Government agencies are made by direct agreement.

Inventory and usage of chemicals at Y-12 is shown below:

	Shipping Container	Unit	Inventory	Monthly Usage
Chlorine Gas	150# CYl	Lb.	11	2
Nitric Acid	7# Bottle	Lb.	13,916	3,276
Nitric Acid	13 Gal. Carboy	Gal.	728	261
Nitric Acid	Tank Car	Gal.	0	19,104
Aluminum Nitrate	540# Bbl.	Lb.	87,599	14,426
Calcium Oxide (Lime)	50# Bag.	Lb.	50,600	15,300
Copper Nitrate (Cupric)	600# Bbl.	Lb.	31,800	1,000
Hydrogen Peroxide	50# Carboys	Lb.	1,500	1,400
Hydrogen Peroxide	Tank Car	Gal.	0	1,900
Sodium Hydroxide	400# Drums	Lb.	43,200	10,200
Carbon Tetrachloride	5# Bottle	Lb.	1,005	178
Carbon Tetrachloride	Tank Car	Gal.	14,308	50
Dibutyl Carbitol		Gal.	3,720	325

IV. RESEARCH, DEVELOPMENT, AND FUTURE PLANNING

A. Curtailment of Production Operations

On December 24, 1946 the Tennessee Eastman Corporation was directed to reduce Y-12 operations to a minimum; at the same time it was indicated that the art of electromagnetic separation should be further developed. With process development as the primary objective, Y-12 was instructed to reduce plant operations to the following levels at the earliest practicable date:

1. Continue the stable isotope separation program at present level.
2. Continue standby maintenance.
3. Continue operation of one Beta track with necessary auxiliaries primarily for development purposes.
4. Continue final chemistry for processing K-25 product and such product as is produced in one Beta track.
5. Continue process improvement and development work.

B. Research and Development

Research and development activities are being directed toward two main objectives:

1. Improvement of the electromagnetic process for the separation of uranium isotopes.
2. Separation of isotopes other than uranium.

In order to meet these objectives effectively, a broad program of applied and fundamental research and development is necessary. It will be necessary to carry on research in a number of allied fields that have a direct bearing on the electromagnetic separation process. Among these will be studies of resonant voltage and magnetic field, arc characteristics, ionization potentials, vapor pressure of charge materials, vacuum techniques, heating systems, drain studies, voltage breakdown, beam radii, accelerating and operating potentials, and micro-wave phenomena.

1. Electromagnetic Program - The calutron unit is to

be studied and tested in its parts so as to evaluate changes for simplifying the unit and increasing its production capacity. Among the parts that are to be studied are sources, receivers, electrodes, filters, grids, magnets, gages, defining slits, tanks, liners, insulators, and others. Along with these studies, research will be carried on to improve and develop methods of control for monitoring the performance of the units.

2. Chemical Program - As a supplement to the electromagnetic process, it will be necessary to carry on certain fundamental chemical operations and studies. These studies will be directed toward four objectives:

a. Initial preparation of charge material.

b. Removal of isotopic products from equipment (cleaning processes).

c. Purification and preparation of charge material from depleted and unused materials (recycle processes).

d. Purification and preparation of final product.

3. Isotope Program - Research will be carried on in the field of stable isotope separation and development. Specific aims are:

a. Development of equipment usable for collection of stable isotopes in quantities sufficient to meet demands.

b. Interpretation and improvement of methods of operation.

c. Application of the information gained in the isotope development program to the development of the electromagnetic separation process, and the improvement of the calutron unit.

PART 3 - CLINTON PRODUCTION DIVISION ORGANIZATION

I. GENERAL

The function of the Clinton Production Division is to administer, for the Atomic Energy Commission, all activities pertaining to the operation of the electromagnetic and gaseous diffusion plants, including laboratory and engineering research and development, procurement, engineering and design, maintenance, and construction in connection with the operation of the plants, as well as related off-site activities. Areas operating under the Clinton Production Division are Decatur, Illinois; Detroit, Michigan; Milwaukee, Wisconsin; and (in part) Buffalo, New York. The terms of the various contracts involved, and policies of the Atomic Energy Commission, Federal and State Laws, and other Governmental Agencies, such as the General Accounting Office, are followed in discharging this function.

The Clinton Production Division has a personnel strength of approximately 125, and is composed of three branches functioning for the entire Division, the Administrative, Industrial Services, and Property Branches; three branches located at the K-25 area, the Plant Operations, Research and Development, and Engineering, Supply, and Services Branches; and three branches located at the Y-12 area, the Electromagnetic Development and Production, the Chemical Development and Production, and the Engineering, Supply and Services Branches, in addition to Y-12 staff personnel. The current organization chart is shown on Page A-I-2.

See Sheet #2

CLINTON PRODUCTION DIVISION

Chief - Lt. Col. R. W. Cook
Deputy Chief - J. C. Robinson
Ass't. to Chief - F. R. Dowling

2 others

PERSONNEL	
OFFICERS	2
ENL.	0
P	27
S P	1
C A F	93
C P C	18
MISCL.	0
VAC.	7
TOTAL	148

See Sheet #3

ADMINISTRATIVE BRANCH

F. F. Blakely
6 others

See Sheet #4

INDUSTRIAL SERVICES BRANCH

J. Hannoch
8 others

See Sheet #5

**** AUDIT BRANCH**

E. N. Ziegler
28 others

See Sheet #6

PROPERTY BRANCH

V. L. Looney
11 others

Y-12 OPERATIONS

J. C. Robinson

K-25 OPERATIONS

Lt. Col. R. W. Cook

See Sheet #7

STAFF

10 Total

See Sheet #8

ELECTROMAGNETIC DEV. AND PRO. BRANCH

St. G. T. Arnold
3 others

See Sheet #9

CHEMICAL DEV. AND PRO. BRANCH

Dr. R. J. Speers
3 others

See Sheet #10

ENGR., SUPPLY, AND SERVICES BRANCH

H. Williams
10 others

See Sheet #11

PLANT OPERATIONS BRANCH

W. H. Rogers
6 others

See Sheet #12

RESEARCH AND DEV. BRANCH

Chief (V-MR)
2 others

See Sheet #13

ENGR., SUPPLY, AND SERVICES BRANCH

F. H. Belcher
16 others

M.S.A. - Tonawanda

*F. R. Dowling

S-50

*R. Owen

See Sheet #14

MILWAUKEE SUBOFFICE

*J. D. Anderson
3 others

See Sheet #15

DECATUR SUBOFFICE

F. C. Hungerford
28 others

DETROIT AREA

*Capt. J.D.McCormick

*As required
**Assignment of K-25 Audit functions to C.P.D. is pending.

ORGANIZATION CHART
U.S. ATOMIC ENERGY COMMISSION
AEC FORM 30 (JAN. 17, 1947)

UNIT CLINTON PRODUCTION DIVISION

SUBMITTED J F Blakely DATE JUN 21 1947

RECOMMENDED [illegible] DATE JUN

APPROVED [illegible] DATE

II. FUNCTIONS

A. Division Level

1. Chief, Clinton Production Division - The Chief of the Clinton Production Division is in responsible charge of the operation of the Division, reporting directly to the Director of Operations, Atomic Energy Commission. He plans, directs, and coordinates the work of all organizations connected with the Division, which include several Government offices employing approximately 150 persons, as well as several prime contracts and sub-contracts, the contractors of which employ in excess of 8000 people. The Chief also acts as a consultant to the Director of Production, Atomic Energy Commission, in operational coordination with other facilities of the Commission, and in evaluating and determining future operating schedules.

2. Deputy Chief - The Deputy Chief has full contractual authority, and is specifically responsible for operation and research activities pertaining to the Y-12 plant.

3. Assistant to Chief - Assists the Chief in coordinating, directing, and following up on all work and responsibilities of the Division; consultant to, and coordinates activities of, the various branches of the Division, insuring that established policies are complied with. Reviews contracts and sub-contracts for overall sufficiency, for engineering technicalities, and for compliance with applicable regulations. Coordinates activities of outlying offices of the Division, including Decatur, Detroit, Milwaukee, and Tonawanda. Duly authorized representative of the Contracting Officer with limited authority.

B. Staff Level

1. Administrative Branch - Plans and directs administrative functions of the Clinton Production Division; maintains close liaison with operating contractor's key personnel on reimbursement and administrative procedures; interprets contract and contractor's policy in administration of the work being performed under the contract; acts as duly authorized representative of the Contracting Officer with authority limited to approval of contractor's travel, overtime, sick and vacation leave, procurement requisitions, purchase orders in amounts not in excess of $5,000 each, and salaries and increases in salaries up to and including $10,000 per year.

2. Industrial Services Branch - The Chief of the

Industrial Services Branch, working under the general administrative direction of the Division Chief, is in direct charge of the Safety, Fire Prevention and Protection, and Security Sections. He performs responsible work in preventing or eliminating hazards in connection with occupational hazards, safety provisions, unsafe working conditions, design of appliances, fire prevention facilities, fostering sound security program to safeguard classified operational information and to prevent subversive activities, espionage and sabotage, and the planning and organization of safety educational programs incident to the maintenance, construction, alteration, and operation of all facilities under the jurisdiction of the Clinton Production Division.

3. Property Branch - The Chief of the Property Branch serves in the capacity of Accountable Property Agent, assuming and maintaining accountability for all Government property furnished to, or acquired by, the numerous contractors under the jurisdiction of the Clinton Production Division. Accountable for class A, B, and C property having an estimated value of approximately one billion dollars, including real property such as land, buildings, utilities, roads, operating equipment, and facilities installed therein. Is responsible for audit, review, and supervision of contractors in maintaining property responsibility and accountability records. Property under his jurisdiction is located at the Y-12 and K-25 areas, including that assigned to the Southern Railway and the property stored in the S-50 area in standby, and the Decatur and Milwaukee standby plants. Also included is property such as machine tools, jigs, dies, patterns, and fixtures located at plants of private corporations under storage rental agreements with Carbide and Carbon Chemicals Corporation.

C. K-25 Office

1. Plant Operations Branch - Chief of the Plant Operations Branch reports to the Division Chief on all matters relating to plant operations, plant engineering and maintenance, and research and special materials. He and his staff review operating reports and keep informed of all changes of plant operations; investigate interruptions in operation of the process area and their effect on plant productivity; keep abreast of all activities of the contractor regarding special materials, production data, research relating to improvement of operations, plant improvements, and routine laboratory work. Maintains radioactive and fissionable material accountability records. Performs duties incident to engineering

and maintenance of mechanical equipment within the manufacturing plants. Represents the Division Chief on a committee, including contractor personnel, which reviews and approves all requests for changes in plant equipment.

2. Research and Development Branch - Chief of the Branch works under general administrative direction of the Division Chief, and is responsible for all research and development activities, for all experimental and plant protection functions associated with radioactive and criticality hazards, and for special liaison between K-25, Y-12, and other Atomic Energy Commission installations. Responsible in a supervisory capacity for the coordination, scheduling, planning, expediting, and achievement of all research and development projects related to the K-25 gaseous diffusion plant, and of the chemical research and development projects related to chemical production, analytical and assay operations, and final product preparation at the Y-12 electromagnetic separation plant.

3. Engineering, Supply, and Services Branch - Acts on matters pertaining to engineering, power plant, supply, and expediting, and as representative of the Contracting Officer in approving contractor's procurement requisitions. Reviews requests for new construction on the basis of necessity, economics, engineering soundness, and compliance with policy and directives. Makes regular inspections of existing facilities and new work, taking or recommending action when advisable. Reviews, coordinates, inspects, and expedites contractors procedures and operations of purchasing, property transfers and disposal, warehousing, material control and handling, transportation and equipment, salvage and survey.

D. Y-12 Office

1. Electromagnetic Development and Production Branch - Provides information required in rendering decisions concerning process operations and equipment; anticipates potential difficulties and plans satisfactory preventive measures; maintains close liaison with, and follows work of, all process research groups. Through study of the results obtained, anticipates need for future research, recommending the proper group and site for such programs; advises higher authority what developments can be incorporated into the production process, the timing of such incorporation, and the effect on production; co-operates with the Engineering Branch regarding proposed work pertaining to process operation.

2. Chemical Development and Production Branch - Provides

information required in rendering decisions concerning chemical operations, equipment and analytical procedures; anticipates potential difficulties and plans satisfactory preventive measures; maintains close liaison with, and follows-up work of, all chemical research groups, and through study of the results obtained, anticipates need for future research, recommending the proper group and site of such programs; advises the Division Chief what development can be incorporated into the chemical process, the timing of such incorporation, and the effect on production. Co-operates with the Engineering Branch regarding proposed work pertaining to chemical production.

3. Engineering, Supply, and Services Branch - Responsible for authorization, approval of design, and execution of plant improvements and alterations; supervision of maintenance and stand-by activities; operation of utilities; co-ordination of safety program; observance of plant security and supply control. Maintains contact with operating contractor and outside organizations dealing with the above activities.

4. Office Staff

a. Production and Cost Branch - Analyses production and experimental data; evaluates improvements, methods, technical and operating changes for the purpose of increased production and/or reduced unit cost. Makes studies and prepares recommendations involving economies of plant operation, improvement of efficiency, and reduction of expenses. Correlates the activities of the Production Branches from the viewpoint of economy of operation. Responsible for Y-12 Monthly Operational Report.

b. Accountability Branch - As Material Accountability Officer, is accountable for all Uranium, Thorium, Radium, and stable isotopes in the Y-12 Area. Receives all shipments from the contractor, and consigns material to other locations. Periodically furnishes higher authority with reports of inventory within the area and movements between Y-12 and other areas. Maintains records of receipts, shipments, and losses of indicated materials. Verifies and confirms inventory and loss reports prepared by the contractor. Reviews and recommends changes in procedures in material control.

c. Special Hazards and Reports Branch - Co-ordinates overall Division and AEC programs and policies on special hazards with Y-12 activities, maintaining liaison with contractor's Special Hazards personnel. Reviews contractor's program and makes recommendations to higher authority on improvement of program and procedures. Editor of Y-12 History of Electromagnetic

Process. Librarian and controller of Technical Series and other classified reports for the Y-12 area. Makes determination for the declassification of correspondence and documents for other than technical purposes. Co-ordinates the stable isotopes program between the Atomic Energy Commission and the contractor.

d. Administrative Branch - As Assistant to Operations Chief, is responsible for the administration of the operations of Y-12, and co-ordinates the activities of the various branches. Responsible for the execution of Civilian Personnel procedures. Supervises activities of the Y-12 Mail and Records unit.

III. ACTIVE CONTRACTS

CONTRACT NO.	CONTRACTOR'S NAME AND HOME OFFICE ADDRESS	SCOPE OF WORK
W-7405-eng-26	Carbide and Carbon Chemicals Corporation, 30 E. 42nd St., New York, N. Y.	Operation of K-25 and Y-12 plants.
W-7405-eng-178	City of Decatur Decatur, Illinois	Construction of water service facilities and furnishing of water to Decatur facilities on a unit-price basis.
W-7405-eng-179	City of Decatur Decatur, Illinois	Contract gives Government permission to construct a sewer within the city. Government maintains sewer, and city has option to buy same when Government has no further need for it.
W-7407-eng-34	Ford, Bacon, & Davis, Inc. 39 Broadway, New York, N. Y.	Operation of fluorine disposal and acid disposal plants and the conditioning area at K-25 for the cleaning, adjusting, assembling, testing, and storage of process equipment, piping, and other materials for use in the K-25 plant. Contractor relieved of operational responsibility May 1, 1945; Final payment in process of preparation.
W-22-075-eng-133	Chrysler Corporation Detroit, Michigan	Furnish water, light, and heat for Grinnell Street warehouse, Detroit, Michigan.

TOP SECRET
UNCLASSIFIED

CONTRACT NO.	CONTRACTOR'S NAME AND HOME OFFICE ADDRESS	SCOPE OF WORK
W-26-021-eng-69	Taylor Instrument Companies Rochester, New York	Storage, use, and maintenance of Government-owned tools and equipment used by contractor in connection with work under Contract W-7418-eng-14.
W-26-034-eng-29	Linde Air Products Company 30 E. 42nd St., New York, N.Y.	Supply of nitrogen to K-25 and Y-12 Plants.
W-26-034-eng-31	Struthers-Wells Corporation Warren, Pennsylvania	Preparation for storage and storage of Government-owned tools and equipment. Contractor gets $1,458 plus use of certain tools as consideration for storage until October 1, 1950.
W-26-034-eng-32	Pfaudler Company Rochester, New York	Preparation for storage and storage of Government-owned tools and equipment. Contractor permitted to buy one flanging roll from the Government at a reduced price as consideration for storage until October 1, 1950.
W-26-034-eng-34	Cook Electric Co. 2700 Southport St., Chicago, Illinois	Preparation for storage and storage of Government-owned tools and equipment. The contractor has use of tools as consideration for their storage until October 1, 1950.

TOP SECRET
UNCLASSIFIED

CONTRACT NO.	CONTRACTOR'S NAME AND HOME OFFICE ADDRESS	SCOPE OF WORK
W-28-099-eng-47	Southern Railway System Washington, D. C.	Operation and maintenance of rail facilities in the K-25 area.
W-28-099-eng-49	Illinois Power Company Decatur, Illinois	Furnish electric power for facilities in standby at Decatur, Illinois.
W-28-099-eng-71	Boudaille-Hershey Corporation Detroit, Michigan	Expert technical services in connection with the disposal of surplus materials at the Garfield Plant, Decatur, Illinois.
W-31-109-eng-48	Reconstruction Finance Corporation, Washington, D.C.	Rental of Grinnell Street warehouse, Detroit, Michigan.
W-31-109-eng-43	Boudaille-Hershey Corporation Detroit, Michigan	Rental of Government-owned equipment.
W-31-109-eng-67	Roy W. Christy Decatur, Illinois	Maintenance of Garfield Plant in standby at Decatur, Illinois.
W-38-099-eng-108	American District Telegraph Company, Detroit, Michigan	Protection services for Grinnell Street warehouse, Detroit, Michigan.

DISTRIBUTION

1. K-25 Site Records (RC)
2. ChemRisk/Shonka Research Associates
3. DOE Public Reading Room
4. S. G. Thornton (K-25 EMD)